VOL. 5 No. 11 November, 1961

COMPUTER ABSTRACTS

Editor: B. A. Fancourt, B.Sc.

Published by Technical Information Company, Ltd., Chancery House, Chancery Lane, London, W.C.2.

CONTENTS

GENERAL 1
DESIGN 2
LEARNING AND PATTERN RECOGNITION .. 3
MATHEMATICS 7
TECHNIQUES 7
ACCESSORIES 9
ELEMENTS 10
ANALOGUE 12
DIGITAL 12
PROGRAMMING 12
APPLICATIONS
Aero- and Astronautical 14
Business 14
Chemical 15
Control—General Systems 15
Control—Production and Process 15
Electronics 15
Engineering, Electrical 15
Engineering, Structural 15
Information Retrieval 16
Mechanical Translation 16
Medical 16
Military 16
Nuclear 17
Physics 17
Simulation 17
Transport 17
Miscellaneous 17
BOOKS 18
AUTHOR INDEX 19
PATENT INDEX 20

GENERAL

2367 **The Applied Mathematics Laboratory of the David W. Taylor Model Basin.** M. Richstone, *Commun. ACM*, **4,** Sept. 1961, 372-375. An historical account of the contributions and achievements, the staff, equipment and organisation of the Applied Mathematics Laboratory of the U.S. Navy's David W. Taylor Model Basin. 5 refs.

2368 **A basic limitation on the speed of digital computers.** W. W. Bledsoe, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 530. Letter pointing out that the trend towards faster computers cannot continue indefinitely since there is an inherent quantum-mechanical limit to the speed obtainable. It is shown that the access time must be greater than $\sqrt[4]{N/d}\ 10^{-20}$ sec., where N is the number of bits of randomly accessed storage and d is the average density (in grams/cm^3) of the material used in constructing the memory. 2 refs.

2369 **Computer-related sciences (synnoetics) at a university in 1975.** L. Fein, *Datamation*, **7,** Sept. 1961, 34-41. This paper is presented as 'a reprint of an address to an alumni audience in the year 1975 by the president of one of the major universities in the U.S.' In the paper, *synnoetics* is defined as 'the science of treating of the properties of composite systems—consisting of configurations of people, mechanisms, plant or animal organisms, and automata—whose main attribute is that its ability to invent, to create, and to reason—its "mental" power—is usually greater than the "mental" power of its components'. The paper consists largely of an account of the organisation, activities and history of the University Synnoetics Department.

2370 **Erfahrungen beim Betrieb eines herstellerunabhängigen Rechenzentrums.** (Experience with the organisation of manufacturer-independent computing centres.) H.-K. Schuff, *Elektronische Datenverarbeitung*, No. 4, 1961, 167-170. (In German) After a brief discussion of different types of computing centres, this paper considers the computing service centre which is independent of computer manufacturers. Matters which are discussed include the establishment of a program library, discretion, terms of service, problem analysis, selection of a computer, costs and charges.

2371 **Errata.** D. E. Knuth, *Commun. ACM*, **4,** August 1961, 355. The author demonstrates that the statement, made in his paper 'An imaginary number system', *ibid*, **3,** April 1960, 245-247 (*C.A.*, **4,** July 1960, Ref. 1095), that every complex number has a *unique* representation in an n-imaginary number system is erroneous.

2372 **Integrated data processing in Britain and America.** D. P. Kilner, *Computer Bull.*, **5,** Sept. 1961, 67-69. A short report of the Conference under the above title organised by the British Productivity Council and held on 24 May, 1961.

2373 **Japanese computers.** I. Takasaki, *Data Processing (Detroit)*, **3,** Sept. 1961, 17-19. A brief account of computer developments in Japan.

2374 **Need for Fire Standard for computer areas.** E. H. Goodman, *Data Processing (Detroit)*, **3,** Sept. 1961, 46-47. Details are given of ten fires in the U.S.A. which involved computers, associated equipment and records. A brief account is given of the activities of the National Fire Protection Association Committee on Electronic Computers Systems in devising a comprehensive code as a standard for computer area fire safety.

2375 **Programmer selection survey.** J. Watson, *Data Processing (Detroit)*, **3,** Sept. 1961, 9-13. Results of a survey of some variables involved in selection of programmers are presented. Information was obtained by means of a questionnaire sent to computer users in the United States and Canada. Matters covered include programmer recruitment programmes, number of programmers per computer, background required, minimal educational requirements, sources of programmers, testing techniques, average age of newly hired programmers and average annual starting salary.

2376 **Simulating computers with people.** B. E. Howard, *Computers & Automn.*, **10,** August 1961, 23-25. This article describes how, as an introduction to the nature of automatic digital computation, a class of 20 students simulated the iterative part of a square root routine as programmed for the IBM 650. The basic idea was to have each student act as a single functional component and to follow his instructions exactly, being careful not to think.

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2377 **Some basic terminology connected with mechanical languages and their processors.** S. Gorn, *Commun. ACM*, **4,** August 1961, 336-339. This paper proposes certain logically connected portions of a glossary intended to be used only for specification of computer languages and their processors. 2 refs.

2378 **The total systems concept and how to organize for it.** J. M. Ewell, *Computers & Automn.*, **10,** Sept. 1961, 9-13. After discussing various definitions of 'total systems', the author states that to Proctor & Gamble it means their entire business involving the parent company and its subsidiaries made up of many line and staff divisions throughout the world. The main part of the paper describes how Proctor & Gamble have applied the total systems concept to the organisation of data processing activities.

2379 **Brochures on electronic computers and instruments.** *AD-258459*, 19 Jan. 1961, 142 p., $11.00. (Translated from *Tsentral'noye Byuro Teknicheskoy Informatsii*, Moscow, 70 p.)

DESIGN

2380 **Autocorrelations for Boolean functions of noiselike periodic sequences.** B. M. Eisenstadt and B. Gold, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 383-388. One method of generating a waveform whose correlation function resembles that of noise is by means of combinations of periodic binary sequences. In this paper the properties of the correlation function for arbitrary functions of n periodic binary sequences are investigated. An especially simple formulation is obtained when each binary variable in all the sequences has equal probability of being 0 or 1. For this case, it is shown that there are only two functions which result in a correlation function like true purely random noise. One of these two functions corresponds to addition modulo 2. Also, the correlation for the case of a random function of n sequences is derived. Finally, expressions are obtained for the number of degenerate Boolean functions. 3 refs.

2381 **Axiomatic majority-decision logic.** J. P. Larkin, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 530. Letter pointing out a misleading omission in the derivation of an equation in the above-titled paper, M. Cohn and R. Lindaman, *ibid*, **EC-10,** March 1961, 17-21 (*C.A.*, **5,** April 1961, Ref. 629).

2382 **Cascaded finite-state machines.** A. Gill, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 366-370. In this paper, *networks* of finite-state machines, rather than individual machines, are discussed. The investigation centres around *cascade* networks, where the output of one machine serves as an input to another. It is shown how, by means of connection matrices, the characteristics of such a network can be obtained from those of the component machines, and how a specified machine can be decomposed into a number of cascaded components. The advantages of such a decomposition, as well as some of the problems that remain to be solved in this area, are discussed. 5 refs.

2383 **Core memory sense amplifier.** R. A. Leightner, *IBM Technical Disclosure Bull.*, **4,** Sept. 1961, 44. Description of a transistor circuit which amplifies sense pulses from a core memory in a manner to block half-select noise signals from the output.

2384 **Functional design of computers.** R. S. Barton, *Commun. ACM*, **4,** Sept. 1961, 405. Brief account of an investigation with the object of developing improved machine organisations to increase efficiency in the handling of large and complex programs, both in preparation and execution. Programming languages were taken as a possible guide to better functional design. The investigation led to the functional design of the Burroughs 5000 Information Processing System. 1 ref.

2385 **Improvement of electronic-computer reliability through the use of redundancy.** W. G. Brown, J. Tierney and R. Wasserman, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 407-416. This paper is concerned with the application of redundancy to logic circuits to improve computer reliability. Various redundant configurations are considered. From all of the considerations, the majority gate provides a practical method of increasing reliability. For operating periods which are short compared to the mean time to failure of the elements, a substantial increase in system reliability is obtained with majority gate redundancy. (This paper is based on the report *PB 154087* (*C.A.*, **5,** Aug. 1961, Ref. 1614).)

2386 **Minimizing incompletely specified sequential switching functions.** R. Narasimhan, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 531-532. Letter referring to 'Minimizing the number of states in incompletely specified sequential switching functions', M. C. Paull and S. H. Unger, *ibid*, **EC-8,** Sept. 1959, 356-367 (*C.A.*, **4,** July 1960, Ref. 1099) and commenting that, in that paper, the analysis of incompletely specified functions is somewhat ambiguous and leaves the impression that incomplete specification of next-states and that of the outputs are of equal intrinsic significance to the minimisation problem. Some connections between the results of Paull and Unger and those of the author on the synthesis of finite-state machines are pointed out. 3 refs.

2387 **Orthogonal functions for the logical design of switching circuits.** R. P. Coleman, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 379-383. This paper presents a new approach to the mathematical representation of switching functions. It was developed in connection with a theoretical study of magnetic core logic, but the results are considered to be more basic and general than the core logic problem. The ampere-turns (MMF) expression for core switching is shown to be part of a special type of Fourier series expansion of a switching function, in which the turns are directly related to the spectrum of the function. Fourier transform methods, used for analysis of X-ray diffraction, are adapted to the representation of switching functions. The method leads not to Boolean algebra, but to ordinary algebra in terms of the orthogonal functions

$$(-1)^{k_1x_1 + k_2x_2 + \ldots k_nx_n}$$

where $x_1, x_2, \ldots x_n = 0, 1$, and $k_1, k_2, \ldots, k_n = 0, 1$.

Methods of application are described for magnetic core logic and for character recognition.

2388 **Parity flow shifter.** W. G. Swenson, S. F. Anderson and R. L. Eibsen, *IBM Technical Disclosure Bull.*, **4,** Sept. 1961, 14-16. A description is given of a system whereby final parity, for each of two data words being shifted, is developed by combining an original parity value with a change factor. This reflects the net parity of bits lost and gained by shifting across the word boundaries. Final parity thus maintains the error-correctness characteristics of the original parity.

2389 **Program-interrupt system.** G. A. Blaauw and W. Y. Stevens, *IBM Technical Disclosure Bull.*, **4,** Sept. 1961, 20-22. Description of a program-interrupt system which can load information required for a priority program into the computer registers, while at the same time retaining the information necessary to resume with the current, ordinary program at the point of interruption. The system includes an alert trigger, an AND, a mode trigger, a fixed address device and a portion of the program unit.

2390 **The realization of symmetric switching functions with linear-input logical elements.** W. H. Kautz, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 371-378. The problem of synthesising switching networks out of linear-input (threshold) elements is studied for the class of symmetric switching functions. Tight bounds are derived for the number of elements required in a minimal realisation, and a method of synthesis is presented which yields economical networks. Minimal networks result for all symmetric functions of no more than about 12 variables, and for several other cases. In particular, it is shown how the parity function of any number n of variables can be realised with about $\log_2(n)$ elements. 8 refs.

2391 **Some thoughts on digital components and circuit techniques.** A. W. Lo, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 416-425. In this paper, signal standardisation and control directivity are emphasized as the basic physical requirements in considering components and circuit techniques for the handling of digital information. The significance of and the ways and means of meeting these requirements are illustrated by consideration of the operation of the parametric phase-locked oscillator. A classification of digital-gain elements, accompanied by illustrative comments, is presented to offer a unified viewpoint on digital components and circuit techniques in connection with present practice and prospective future development. The classification is as follows: (A) Continuous-impedance control—(1) 4-terminal resistance-controlled elements (electromechanical relays, cryoelectric devices, optoelectric devices), (2) 3-terminal resistance-controlled devices (tubes, transistors), (3) 2-terminal reactance-controlled elements (nonlinear inductors, nonlinear capacitors); (B) Stored-impedance control—(1) carrier-storage devices, (2) ferroelectric devices, (3) ferromagnetic devices; (C) Regenerative-impedance control—(1) parametric phase-locked oscillators, (2) negative-resistance diodes. 24 refs.

2392 **UNIVAC-LARC high-speed circuitry: case history in circuit optimization.** N. S. Prywes, H. Lukoff and J. Schwarz, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 426-438. This paper discusses how circuit optimisation techniques and the use of the UNIVAC I aided in reducing cost and avoiding many of the pitfalls in the design and production of efficient high-speed circuitry for UNIVAC-LARC. 18 refs.

2393 **AC and impulse switching techniques for use with magnetic memories.** R. E. McMahon, M.I.T., *AD-259503,* 26 June 1961, 22 p., $2.60. The application of a high frequency drive current to cores that have been partially switched by an impulse current was used in extending the previously developed model of switching. The ac drive combined with impulse switching also provides additional techniques for use in magnetic circuit designs.

2394 **Majority logic analysis.** R. Miller, Hermes Electronics Co., *AD-242606 (PB 150112),* 15 Aug. 1960, 20 p., $1.60. Consider a basic sequential digital system (one two-out-of-three gate on three functional units) with reliability P. Applying simple majority logic to the system gives reliability equations of the form: $R_m=\left[GP^{\frac{k}{n}}(3-2P^{\frac{k}{n}})\right]^{\frac{n}{k}}$, where G is the reliability of a two-out-of-three majority gate. For preliminary analysis, no functional relation between P and G is assumed, although there may be similarities between components of the system and components of the majority gate. Let $\frac{k}{n}=\lambda$. The reliability equations become $R_m=[GP^{2\lambda}(3\text{-}2P^{\lambda})]^{\frac{1}{\lambda}}$. The term P^{λ}, representing the reliability of a discrete, single output bit processing component of the system, is called the building block reliability. The problem is to choose λ so that R_m is maximised. The actual system then has a compromise form with reliability given by the expression: $[GP^{2\lambda i}\ (3\text{-}2\ P^{\lambda i})]^{s}$ where s is an integer such that $\Sigma\lambda i=1$, $i=1, \ldots s$.

2395 **Organization of computer systems—The Fixed Plus Variable Structure Computer.** G. Estrin, California University, Los Angeles, *AD-240399 (PB 149851),* 1960, 8 p., $1.10. Aspects of digital technology related to extending the bounds of practical computability are characterised. A new concept of computer system organisation is proposed. 17 refs.

2396 **Parallelism in computer organization random number generation in the Fixed-Plus-Variable Computer System.** M. Aoki, G. Estrin and T. Tang, California University, Los Angeles, *AD-258992,* 1960, 16 p., $1.60. Special purpose circuits can be designed to generate pseudo-random numbers in parallel with other activities such that these numbers are available on demand in the same sense as any other operand stored for use in the computation. A number of different methods of generating pseudo-random numbers, the time required in existing programs, the hardware implications of different parallel and serial designs are discussed. The criteria for choice of one method over another in the context of particular problems and the Fixed-Plus-Variable Computer System are evaluated.

2397 **Project Lightning.** Int. Business Machines Corp., *AD-259229,* 30 Nov. 1960, 119 p., $10.10. Work was continued in cryogenics and associated machine organisation devoted to evaluating the feasibility of a computer system capable of performing basic logic operations at a rate of 1000 Mc/s. It was concluded that substantial improvement in the efficiency of a kilomegacycle cryotronic machine can be obtained by reducing the planar dimensions of the circuits and using a substrate having high thermal conductivity. Efforts were made to find substrates which can be used for circuits and which will alleviate the heat problem by increasing the thermal conductivity to the bath. A first set of results was obtained in the multiplexing study and preliminary data on the effect of queue length are reported. A plan to design and construct a high-speed addressable memory was prepared. The modifications of the cryotron network simulator resulted in simulation results that agreed with experimental results for slow crossed-film cryotron circuits.

2398 **Solid-state logical transducers.** F. E. Battocletti, A. C. Thomas et al, Ohio State University, *AD-258579,* Feb. 1961, 35 p., $3.60. One central problem in switching function theory is the classification of all binary switching functions of a given number of input variables into equivalence classes by rearrangement and negation of the input variables. Several theorems describing properties of the switching functions which result in various types of symmetries of the functions under input rearrangement and negation are presented. The analysis is based on the representation of the switching function in terms of set vectors from a finite dimensional vector space over the field of integers modulo 2. This approach makes use of the properties of the groups of transformations on the vector space which are related to the input rearrangements and negations. One type of solid-state logic unit investigated was the field-effect transistor with 2 control gates located concentrically around the source terminal. Another approach to the problem of realising multiple input logic functions is to employ 4-layer diodes coupled internally in a single piece of semiconductor. A number of 4-layer diodes were fabricated and tested with external coupling. 16 refs.

2399 **Arithmetic unit.** Philips Electrical Industries Ltd., *B.P. 876988,* 6 Sept. 1961. This patent describes an arithmetic unit for a digital computer which, in order to increase its speed, is divided into sections and carries from one section to the next are held in storage devices for subsequent transfer under control of a clock pulse.

2400 **Parallel binary computer circuitry.** Research Corp., *U.S.P. 2994478,* 1 Aug. 1961. Parallel binary arithmetic circuitry is described in which addition operations are accompanied by an inherent shift with the result that an arithmetic operation such as multiplication by repeated addition is accomplished at a higher speed.

2401 **Decoding circuit.** Int. Business Machines Corp., *U.S.P. 2994852,* 1 Aug. 1961. This patent is concerned with the design of transistor circuitry to effect decoding or other operations at high speed with a small number of transistors. The particular circuit described is intended to perform a decoding operation on 5 binary digits and provide 32 outputs.

See also :—
General: Ref. 2368.
Learning and Pattern Recognition: Ref. 2441.
Techniques: Ref. 2467.
Applications, Electronics: Ref. 2596.
Applications, Simulation: Ref. 2616*i*.

LEARNING AND PATTERN RECOGNITION

2402 **An analog method for character recognition.** W. H. Highleyman, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 502-512. This paper presents a method of character recognition which is capable of an analogue implementation and describes its study by simulation on an IBM 704. Essentially, the method involves maximising the cross-correlation value between the unknown character and a set of average characters, there being one average character for each allowed character class (i.e., the collection of all the symbols that are identified as a particular character). An average character is represented by a two-dimensional function. The value of this function at a point is the probability of the occurrence of a mark at that point for the character class represented by the average character. Negative weights are given to areas of low probability in each average character to improve discriminability. The simulation results indicate that the method is applicable to the recognition of machine printing, and possibly to the recognition of constrained hand printing. An economical implementation of the method by electro-optical techniques is outlined. Essentially there is for each character a combination of an average character-representing transparency and a photomultiplier. 6 refs.

2403 **Autocorrelation function generator.** L. P. Horwitz, *IBM Technical Disclosure Bull.,* **4,** Sept., 1961, 48-49. The autocorrelation function $D(x',y')$ of an input pattern $f(x,y)$ is defined as

$$D(x',y')=\sum_{x,y} f(x,y)\cdot f(x+x', y+y')$$

where $f(x+x', y+y')$ represents the input pattern shifted by an amount x',y'. A description is given of an arrangement for simulating this expression optically by superimposing the shifted pattern and measuring the areas that are common to both patterns. The shift is produced by deflection of the beam of a cathode ray tube having a photocathode on which an image of the input pattern is projected. Light from the cathode ray tube screen, after passing through the input pattern, is received by a light-sensitive element.

2404 **Automata theory.** R. Laing, *Commun. ACM,* **4,** Sept. 1961, 406. Brief statement regarding research at the University of Michigan with the object of finding effective analysis and synthesis procedures for fixed automata, growing automata and Turing machines. 10 refs.

2405 **Interpretation of speech sound sequences.** R. Bakis, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 26. In many devices for interpreting speech sound sequences, such as speech recognition systems, the sound sequences that correspond to each reference word are stored as a dictionary. It is suggested that, since there are several, or many, acceptable sound sequences for each word, the dictionary may be reduced in size by storing sequences of *groups* of sounds that should or should not occur.

2406 **Nerve-net simulations.** R. Laing, *Commun. ACM,* **4,** Sept. 1961, 405. Brief account of an IBM 709 simulation of a nerve-net at the University of Michigan, which it is hoped will exhibit 'biological' nervous behaviours, possibly including rudimentary learning. 2 refs.

2407 **Pattern recognition by moment invariants.** M.-K. Hu, *Proc. IRE,* **49,** Sept. 1961, 1428. Letter outlining a pattern recognition theory, based on a set of two-dimensional moment invariants, according to which geometrical patterns and alphabetical characters can be identified independently of their position, size and orientation. The derivation of two moment relations which are invariant under translation, similitude and rotation is indicated and it is stated that a successful program using only these two invariants has been written for the LGP-30.

2408 **The simulation of cognitive processes: an annotated bibliography.** P. L. Simmons and R. F. Simmons, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 462-483. A brief introduction to the literature of simulation of cognitive processes is followed by 498 annotated references arranged in alphabetical order of author. A very broad subject index is provided.

2409 **Simulation of human understanding of languages.** M. R. Quillian, *Commun. ACM,* **4,** Sept. 1961, 406. Brief account of research with the purpose of providing an artificial, quantitative language which represents the meaning of natural language words in a form functionally equivalent to human 'understanding' of them. 2 refs.

2410 **The simulation of three machines which read rows of handwritten Arabic numbers.** L. A. Kamentsky, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 489-501. This paper describes the simulation of three character reading machines for rows of handwritten Arabic numerals by means of an optical scanner and an IBM 704. The three simulated machines differ in the constraints placed on the writing of the numerals (different arrangements of guide marks and in one case no guide marks) and in the complexity of the reading systems themselves. After a discussion of mapping scans and how they are used in the three methods, the methods are described and the experimental results achieved with each are presented. Each method comprises three basic steps: the production on the IBM 704 of a magnetic tape for directing the operation of the scanner by specifying the co-ordinates of a line-by-line scan on a cathode ray tube; scanning of documents as directed by the tape to produce an output magnetic tape carrying a sequence of bits indicating whether each segment of a scan did or did not cross a mark on the document; and the processing of the output tape by the IBM 704. 8 refs.

The following abstracts, Refs. 2411 to 2439, are of the papers contained in *Bionics Symposium held in Dayton, Ohio, 13-15 September 1960—PB 171258* (see Ref. 2628).

2411 **Bionics—new frontiers of technology through fusion of the bio and physio disciplines.** J. E. Keto, *Bionics Symposium,* 1960, 7-12. The keynote address at the Bionics Symposium held in Dayton, Ohio 13-15 September 1960. The definition and scope of bionics is considered: 'Bionics is a new word for an interest that has intrigued man for many generations. . . . Perhaps the real significance of the new term at this time is in providing a challenge to the development of a major advance in the understanding of the function, characteristics, and phenomena that we find in the living world and the application of this know-how toward new devices and techniques for the machine world. . . . In very simple language, we are trying to cross-couple the know-how that we have achieved, or are achieving, concerning living prototypes toward the solution of engineering problems.' The interest in bionics is discussed from the Air Force and Military, and the humanitarian aspects. Man's understanding of the physical and living worlds is compared. The possibility of great advances in science and technology arising from bionics is discussed. 2 refs.

2412 **Attitudes toward intelligent machines.** P. Armer, *Bionics Symposium,* 1960, 13-39. This paper analyses some of the attitudes and arguments which have been expressed in dealing with the question of whether machines can think or exhibit intelligence. It is suggested that most of the disagreement is a matter of semantics. The author believes that there is some continuum of behaviour (whether it be called 'thinking' or by some such term as 'information processing') in which men and machines co-exist. He hopes 'that the definition of research on artificial intelligence as an effort to push machines further out in the continuum of intelligent behaviour will reduce some of the semantic difficulties surrounding discussions of such research.' The author discusses at some length the Russian attitude to such research and considers that their belief that it is very important is correct. 53 refs.

2413 **Air Force research on living prototypes.** H. E. Savely, *Bionics Symposium,* 1960, 41-47. The author, a U.S. Air Force biologist, discusses three interrelated aspects of the nervous system of animals from the point of view of living prototypes for engineering applications. These aspects are: the sensory receptors of animals, the integrative action of their nervous systems, and the storage and retrieval of information. 8 refs.

2414 **Background** (to the life sciences in bionics). W. S. McCulloch, *Bionics Symposium,* 1960, 51-54. What is known about neurons and the kinds of difficulties that may happen in their circuit action are briefly indicated; the history of Venn symbols is outlined; and a Sheffer stroke function is explained.

2415 **Properties of a neuron with many inputs.** M. Blum, *Bionics Symposium,* 1960, 55-82. This paper is concerned with the formal neuron, a logical device with well-defined properties, and gives some theorems about the neuron which clarify the interesting properties of circuits using them as components. The formal neuron was postulated as a biological computer component by W. S. McCulloch, who gave physiological evidence for his choice of this model. The neurons can be connected in nets with outputs more reliable than the outputs of the individual neurons. This paper is a mathematical investigation of many-input neurons such as are contained in these nets. 8 refs.

2416 **Reliable computation with unreliable circuitry.** L. A. M. Verbeek, *Bionics Symposium,* 1960, 83-91. After a discussion of the malfunction of formal neurons and of networks of such neurons, an outline is given of the structure of redundant networks composed of such unreliable formal neurons and resulting in reliable logical computation. 12 refs.

2417 **Toward a proper logic for parallel computation in the presence of noise.** J. D. Cowan, *Bionics Symposium,* 1960, 93-148, disc. 149-152. This paper is concerned with the work of J. von Neumann and of W. S. McCulloch, M. Blum and L. A. M. Verbeek on the construction of reliable automata from unreliable components which has demonstrated the effectiveness of introducing redundancy into the structure of such automata by means of the bundling technique. A result of this work is that the information rate in the multiple-line automaton is zero for reliable computation in the presence of noise, which would seem to imply that the capacity for computation of information is zero. In this paper, an attempt is made to define a particular information measure relevant to computation, as distinct from transmission, in order to gain insight into the nature of the above results, and a solution is sought to the problem of realising a nonzero rate for reliable computation. For probablistic logical functions, use of the model consisting of a series combination of an error-free logical function and a noisy binary symmetric channel leads to the conclusion that the realisation of nonzero rates requires the matching of the output of the error-free computation device to the noisy channel. Various many-valued logical schemes are investigated but none realises a nonzero computation rate for arbitrarily reliable computation. It is suggested that the conclusion to be drawn, is not that a nonzero rate is nonrealisable, but that the schemes considered are too simple-minded, and it may be possible, for example, that nonzero rates can be obtained from nets consisting of M-state components, with each neuron computing a different function, the whole operating on input 'bundles' that are not simply non-interacting, but weight input probabilities in some fashion. 22 refs.

2418 **Stability, oscillations, and noise in the human pupil servomechanism.** L. Stark, *Bionics Symposium,* 1960, 153-180. The pupil of the eye acts a regulator of light impinging upon the retina. This paper presents the transfer function and noise characteristics of this stable type zero servomechanism. Phenomena such as instability and oscillations can be demonstrated if the behaviour of the pupil system is modified by changing the experimental conditions. After a description of experimental methods, transfer function analysis is presented. High-gain oscillations and stability are then discussed and pupil unrest is considered as an example of noise in a biological servomechanism. A block diagram representation of the pupil system is presented and, finally, some defining equations for various subentities of the servomechanism which are being used in a digital computer program for simulating the pupil system are discussed. 15 refs.

2419 **Redundancy and linear logical nets.** S. Papert, *Bionics Symposium,* 1960, 181-195. This paper discusses, in a general form, a class of logical computers known under such names as 'neuron nets', 'random nets', 'perceptron', 'conditional probability computers', etc., the purpose being to show that in a certain sense they function by exploiting redundancy and are thus related to the 'infallible' networks reported at the symposium.

2420 **An estimate of the complexity requisite in a universal decision network.** S. H. Cameron, *Bionics Symposium,* 1960, 197-212. In this paper, a decision network is taken to be an assemblage of real components having a number of inputs on which binary signals appear simultaneously and a single output on which a binary output signal appears. The value of the output signal is a function only of the set of input signals. The function of the decision network is to 'decide' whether or not the set of input signals is or is not possessed of some particular abstract feature and to indicate the nature of this decision by means of the output signal. A *universal* decision network has a sufficient number of adjustable parameters and a structure such that sets of parameter values may be found so that the network can render a valid decision relative to all possible abstractions of the input set. This is equivalent to the statement that a universal network of n inputs is capable of realising each of the 2^{2^n} Boolean functions of n arguments for some set of parameter values. The paper is concerned in particular with the threshold operator and it is postulated that the threshold operator is the simplest structure capable of serving as a decision network. A decision network may consist of one or more threshold operators and its complexity is measured simply in terms of the total number of such operators employed in the network. It is shown that it is completely impractical to consider the construction of an actual network of more than a very few inputs which is universal. Furthermore, at least one of the 2^{2^n} abstractions of the input set demands the full complexity of the universal network for its realisation. The vast complexity required is therefore due, not so much to the demand for universality, but to the fact that some abstractions of a field of say 10^3 arguments are intrinsically nonrealisable by means of such a network because the number of threshold operators required exceeds the estimated number of atoms in the observable universe.

2421 **Problems in bio-computer design.** P. M. Kelly, *Bionics Symposium,* 1960, 215-237. In this paper, the author attempts to outline the important trends and significant problems in the field of activity concerned with the creation of electronic systems that will recognise, learn and generalise. The author summarises the problems which become apparent from his discussion by the statement that they are all different aspects of the single problem of the over-all problem of system organisation. In different areas, the problems are as follows: in recognition—pre-organisation versus self-organisation; in generalisation—minimisation of the number of property filters required; in abstraction—problems closely related to internal system organisation; in learning—problems are intimately tied to system organisation and to abstraction. 16 refs.

2422 **Model for a size invariant pattern recognition system.** J. R. Singer, *Bionics Symposium,* 1960, 239-245. This paper outlines a fundamental approach to the design of a computer input system for learned recognition of characters. Size invariance is accomplished by a group transformation of the image. The transformation used is a dilatation group transformation which is best described as a set of electrical pulses, each representing a resolved point of an image border, all travelling uniformly outward from the centre of delay lines arranged in a polar network. By considering time coincidences of these pulses at selected points of the polar array, recognition of an image is accomplished. An organisation of this model which will learn to recognise a set of alphanumeric characters is discussed. 3 refs.

2423 **Integral geometry as a tool in pattern perception.** A. B. J. Novikoff, *Bionics Symposium,* 1960, 247-262. This paper gives an explanation of integral geometry and suggests how it may be of use in designing pattern recognition or pattern discrimination devices.

2424 **Mathematical models in sensory perception.** W. P. Tanner, *Bionics Symposium,* 1960, 263-286. This paper relates to work on the hearing process and covers: (1) the development of mathematical models specifying optimum performance; (2) the design of experiments and the interpretation of data within this framework; (3) a review of the data so far collected; and (4) the development of a descriptive model of the hearing process without reference to specific neural mechanisms. 6 refs.

2425 **A decision logic for speech recognition.** W. C. Dersch, *Bionics Symposium,* 1960, 287-306. An account of experimental work at the IBM San Jose Advanced Systems Development Division Laboratory on the mechanical recognition of speech *without* employing, except for preliminary and supporting analyses, a large-scale digital computer. 30 refs.

2426 **Image processing and functional retina synthesis.** E. E. Loebner, *Bionics Symposium,* 1960, 309-338. This paper applies a unifying point of view, based on a systems approach, to three research activities: (1) the operational methodology of image processing; (2) the inquiry into the mechanics of vision; and (3) the design of electronic image processing equipment. The paper is divided into three sections. The first reviews the various schemes currently employed for image processing. They emphasise pattern recognition and lean heavily on methods derived from programmed digital computers that have been more or less adapted to handle pictorial input data. No self-contained theory on the human or machine discriminability of the various image features exists. A search for basic data needed for such a theory leads to the topic dealt with in the second section, namely the structure and function of the retina. The final section of the paper discusses the development of an analogue of the retina. Such an analogue has been designed using neighbourhood logic operations. The realisability of this analogue by solid-state optoelectronic panel systems has been investigated with an attempt to duplicate the retinal neuron net topology of three cascaded layers of multiply interconnected active elements. 25 refs.

2427 **Nature's contribution to correlation processes.** L. A. de Rosa and L. M. Vallese, *Bionics Symposium,* 1960, 339-352. In this paper, the properties of the human auditory system are discussed with particular consideration of the frequency resolution characteristic which is represented by the phenomenon of localisation. The localisation and processing by which the ear resolves weak signals from noise backgrounds may be explained, at least in part, by nature's use of a correlation process. While the localisation and noise discrimination process could be equally well accomplished by the use of sharp frequency selective filters, filtering in the time domain is a preferred method employed by nature. This paper proposes an electronic analogue for the realisation of similar behaviour and it is shown that it permits the realisation of a considerable noise improvement factor in the case of random noise. 1 ref.

2428 **Synthesis of reliable automata and stable neural nets.** K. K. Maitra, *Bionics Symposium,* 1960, 353-394. This paper is concerned with the problem of synthesizing logical networks that are required to perform logical operations with a high degree of reliability, in which the building blocks are relatively unreliable functional modules. The concept of fallible neurons, postulated by von Neumann and McCulloch, is extended to unreliable conventional logical elements, e.g. AND gates, OR gates, etc., as found in engineering applications. Methods are developed for the analysis of reliability of a class of networks constructed of redundant logical modules, namely, simple triplets and higher order triplets (triplets constructed recursively from simple triplets). The basic tools used in the analysis are probabilistic logic and a so-called 'stability map' tailored to the present problem. The methods are applicable to triplet networks of any complexity and built of logical modules, which in turn are composed of any physical devices. For the purpose of illustration, specific resistor-diode logic realisations are used. It is shown how to synthesize more reliable two-input AND and OR gates by using appropriate triplet configurations of basic AND and OR gate modules of lesser reliability. The behaviour of more complex networks composed recursively from simple triplet structures is studied. 4 refs.

2429 **What good are artificial neurons?** W. A. van Bergeijk and L. D. Harmon, *Bionics Symposium,* 1960, 395-406. This paper presents a particular circuit for an electronic analogue of the nerve cell, such analogues being termed by the author 'neuromimes'. Experiments with these neuromimes which have yielded insight into various properties of the peripheral nervous system are described. By implementing the known operations of the frog's retina some idea has been obtained about the importance of certain anatomical features of the retinal ganglion cells. A neuromime analogue of the external spiral nerve fibres of the cochlea enabled the purpose of these nerves to be suggested and an explanation to be found for phenomena such as recruitment and loudness curves. 7 refs.

2430 **Information processing languages and heuristic programs: a new stage in the Bead Game.** W. R. Reitman, *Bionics Symposium,* 1960, 409-417. In his novel *Das Glasperlenspiel,* Hermann Hesse imagines the development by scholars and scientists of a generalised symbolism—the 'Bead Game', 'capable of expressing the contents and results of nearly all the sciences and of placing them in relation to each other.' This paper is based on the idea that recent work on problem oriented common languages suggests that digital computers, as general information transformers, or symbol manipulators, may one day provide a basis for such symbolisms. A brief review is given of investigations employing information processing languages and heuristic programming in studies of problem solving in mathematics and symbolic logic, in industrial and business problems, in laboratory tasks, in chess playing and in the composition of music. The author then considers in somewhat more detail current and projected work on the Newell-Shaw-Simon General Problem Solver and on a program for composing music. Using these two projects as vehicles, the paper concludes with a discussion of some longer range problems, strategies and aspirations for work with these techniques. 33 refs.

2431 **Mechanical realization of pattern recognition.** P. Metzelaar, *Bionics Symposium,* 1960, 419-435. This paper presents an outline of the work done in the pattern recognition problem area, with the primary emphasis on machines designed to allow performance of some useful recognition function, rather than to serve as a structurally realistic model of a biological recognition mechanism. 27 refs.

2432 **Learning machines.** L. O. Gilstrap and R. J. Lee, *Bionics Symposium,* 1960, 437-450. An historical survey of conceptual or phsyical models of machines that can learn by experience. 53 refs.

2433 **Self-programming techniques in general purpose digital computers.** B. L. Ryle, *Bionics Symposium,* 1960, 451-465. This paper considers the self-programming of general purpose digital computers from the point of view of the simulation of mental activities of humans. The degree of participation of the computer in the over-all development of a program determines the degree to which it can be said to be self-programming. The sequence of operations which a truly self-programming computer system would have to perform are stated. Assemblers, interpreters and compilers are defined and their useful features summarised, and ALGOL is discussed. 47 refs.

2434 **Decision-making processes.** L. H. Steinman, C. K. Gordon, E. B. Ross and J. W. Oliver, *Bionics Symposium,* 1960, 467-476. This paper presents a systematic approach to decision problems which admit of description in terms of the lattice-theoretic structure of a suitable space of functions of time. The application of the design philosophy is illustrated by considering a decision-making system for solving the problem of deploying a ship's guns during time of attack to provide maximum protection.

2435 **What good is bionics?** M. Taube, *Bionics Symposium,* 1960, 479-481. The author considers bionics important as marking 'the end of an era of wonderful nonsense', and suggests that if the bionics approach is to be taken seriously, it is necessary in endeavouring to make a model of a biological system to start, not from the computer or engineering end, but by studying biologic activity and trying to derive formal properties of that activity which can be modelled.

2436 **Where are we now and where are we going?** O. H. Schmitt, *Bionics Symposium,* 1960, 483-486. General consideration of the present status of bionics and of its future.

2437 **How do we get there?** J. E. Steele, *Bionics Symposium,* 1960, 487-490. The author discusses, in general terms, the training and organisation of biologists, mathematicians and engineers for work in bionics.

2438 **Discussion.** W. S. McCulloch, *Bionics Symposium,* 1960, 491-493. The author discusses how the biologist and the engineer differ crucially from the physicist or the chemist.

2439 **Further discussion (Some biological ideas).** P. H. Greene, *Bionics Symposium,* 1960, 495-497. Some of the biological features which differ from present 'biological' machine design are outlined.

2440 **Analysis and simulations of a nerve cell model.** C. Kesler, Cornell University, *AD-259023,* 1 May 1961, 48 p., $4.60. Nerve cell models are mathematical models of biological neurons. In the analysis of such systems inequalities are often encountered. In the nerve cell model discussed, the cell is either active or inactive depending on the weighted inputs to the cell and its threshold. The ability of two types of cell networks to separate a group of stimuli into two classes is the topic of some theorems. Some computer simulations are described.

2441 **Birth, life, and death in microelectronic systems.** B. Widrow, W. H. Pierce and J. B. Angell, Stanford University, *AD-259538,* 30 May 1961, 33 p., $3.60. An adaptive vote taker is proposed which compares the outputs of paralleled redundant system parts in a binary system and determines the most probable answer based on past performance of the separate parts. Initially, the vote-taker assigns equal significance to each redundant part, and (in a binary system) requires that a simple majority of the parts be correct. With experience, the vote-taker continually reduces the weight (significance) of the outputs from those parts that make mistakes, thereby gradually eliminating the defective parts. Thus, the vote-takers (which may also be paralleled if they are unreliable) act as automatic repairmen which delete defective parts of a system. System dependability and life expectancy can be made to exceed the dependability and average life expectancy of the component parts. The heart of an adaptive vote-taker is an element providing variable gain with memory. A variable resistor with memory (memistor) which uses electrochemical deposition or removal of copper to achieve the variable memory was successfully applied to this function. 18 refs.

2442 **Character recognition devices for electronic computers. An annotated bibliography.** K. D. Carroll, Lockheed Aircraft Corp., *AD-251661 (PB 171903),* Nov. 1960, 102 p., $2.50. The literature covering theory, design, equipment and applications of machines that perceive, learn, think and make reasonable inferences or learn to perform acts of skill is presented. These include learning machines, reading machines and machines capable of speech recognition. The period is primarily from 1954 to the present. 311 refs.

2443 **Human memory. A partial model and its implications for retroactive phenomena.** J. Ross, Educational Testing Service, *AD-259526,* May 1961, 118 p., $10.10. After a consideration of experimental and other evidence, about the functioning of human memory, four features were selected as most salient, and a model proposed to account for them. The model is based upon certain concepts borrowed from the computer field and a consideration of information transmission and storage. It is meant to make psychological sense and, at the same time, to be realisable in a computer for a study of its properties. The model led to deductions about phenomena of retroaction, and four experiments were conducted to test the deductions. The first experiment involved coloured geometrical forms and studied the differential effects of interpolated conditions of low and high correlation between colour and form. The second experiment studied the differential effects of variation in a structure of linkages between figures and names on the recall of an ambiguously structured similar situation. The third experiment studied the types of errors caused in the recall of a list of word paired associates by two lists varying in the meaningfulness of the stimulus-response pairings. The fourth experiment studied the effects of training procedures on the recall of doubly structured number matrices, and the differential effects of interpolated tasks, depending upon training procedures. 103 refs.

2444 **Two theorems on error correction.** R. D. Joseph, Cornell Aeronautical Lab., Inc., *AD-242507 (PB 150463)*, 1 Aug. 1960, 7 p., $1.10. For an elementary perceptron with a gamma reinforcement rule, if there exists any combination of reinforcements to the stimuli which will enable the perceptron to correctly classify its environment, the error correction procedure of *PB 161996* is shown to find such a combination in finite time. A necessary and sufficient condition for the existence of such a solution is derived, and the analogous condition for alpha systems is obtained. 2 refs.

See also:—
Design: Ref. 2387.

MATHEMATICS

2445 **Analog computation of covariance matrices.** T. W. Connolly and K. S. Miller, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 533. Letter discussing the basic approach and deriving the underlying mathematical relationship of an analogue computation technique which permits the rapid evaluation of the elements in the covariance matrix of the time-dependent (transient) output of a linear system which is excited by Markovian noise. 1 ref.

2446 **Note on the construction of rational approximations for the error function and for similar functions.** W. W. Clendenin, *Commun. ACM*, **4,** August 1961, 354-355. A rational approximation for the error function is described which has been found useful in a subroutine as an asymptotic expression of improved accuracy. Although the method is along well-established lines, it illustrates the feasibility of a simplified means of determining the basic coefficients for the error function which may be useful in other cases. 5 refs.

2447 **A note on fitting great circles by least squares.** C. F. Marcus, *Commun. ACM*, **4,** August 1961, 353. This paper refers to 'Least squares fitting of a great circle through points on a sphere', L. de Witte, *ibid*, **3,** Nov. 1960, 611-613 (*C.A.*, **5,** Feb. 1961, Ref. 251), in which the problem of fitting a great circle through points on a sphere was solved using spherical coordinates and trigonometry. It is shown that, if rectangular coordinates are used, the problem turns out to be a 3×3 eigenvalue problem and in this context admits a standard solution. 2 refs.

2448 **Putting a hex on e^x.** W. Feurzeig, *Commun. ACM*, **4,** Sept. 1961, 402-404. A family of very fast, high precision and eminently practical exponential evaluation formulae are derived from an indirect formulation for describing e^x. 4 refs.

2449 **Das Verfahren von Runge-Kutta für Systeme von Differentialgleichungen.** (The Runge-Kutta method for systems of differential equations). W. Kuzenko, *Elektronische Datenverarbeitung*, No. 4, 1961, 161-162. (In German) A description is given of the Runge-Kutta method for the solution of systems of differential equations, with particular reference to a program for the Siemens 2002 digital computer.

2450 **The analysis of paired-comparison experiments involving ties.** S.-H. Wong and W. A. Glenn, Virginia Agricultural Experiment Station, *AD-250345 (PB 154794)*, Nov. 1960, 28 p., $2.60. A recently proposed modification of the Thurstone-Mosteller method of paired comparisons makes possible the analysis of data involving ties of observations. The basis of the modification is the assumption that whenever the difference between his responses to two stimuli under comparison lies below a certain threshold, the judge will declare a tie. This threshold and the mean stimulus responses are estimated by least squares. This report presents IBM 650 programs for analysing paired-comparison data and for studying related questions. 2 refs.

2451 **A preliminary investigation of the analog-digital solution of partial differential equations.** S. Max, M.I.T., *AD-259487*, March 1961, 17 p., $2.60. An outline is given of a proposed combined analog-digital system for solving partial differential equations more rapidly than is presently possible. The method involves the use of an analog memory device in conjunction with a small general purpose digital computer. An estimate of the rate of convergence of the system to the exact answer is derived and experimentally verified.

See also:—
Applications, Simulation: Ref. 2616*f*.

TECHNIQUES

2452 **An algorithm for path connections and its applications.** C. Y. Lee, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 346-365. The algorithm described in this paper is the result of an attempt to answer the following question: Is it possible to find procedures which would enable a computer to solve efficiently path-connection problems inherent in logical drawing, wiring diagramming, and optimal route finding? The following types of problems can be solved: (1) To find a path between two points so that it crosses the least number of existing paths. (2) To find a path between two points so that it avoids as much as possible preset obstacles such as edges. (3) To find a path between two points so that the path is optimal with respect to several properties; for example, a path which is not only one of those which cross the fewest number of existing paths, but, among these, is also one of the shortest. The minimal-distance solution has been programmed on an IBM 704, and a number of illustrations are presented. 5 refs.

2453 **Algorithms.** *Commun. ACM*, **4,** August 1961, 339. Consists of the following algorithm (in ALGOL 60) and certification (of successful use of a previously published algorithm):—

a. **Algorithm 68: Augmentation.** H. G. Rice. This algorithm makes use of the implicit defined recursive properties of ALGOL procedures to compute the augment of x by y, using the basic technique of incrementation by unit step size.

b. **Certification of Algorithm 52: A set of test matrices.** H. E. Gilbert. Brief statement regarding the translation to FORTRAN and testing with a matrix eigenvalue program on the Control Data 1604 at the University of California, San Diego, of the algorithm published in *ibid*, **4,** April 1961, 180 (*C.A.*, **5,** Sept. 1961, Ref. 1885*l*).

2454 **Algorithms.** *Commun. ACM*, **4,** Sept. 1961, 392. Consists of the following algorithm (in ALGOL 60) and certification (of successful use of previously published algorithm):—

a. **Algorithm 69: Chain tracing.** B. H. Mayoh. This procedure is given a list of pairs of integers, the second being related to the first in some way. It finds those pairs of integers which are related to each other if the relation is transitive.

b. **Certification of Algorithm 40: Critical path scheduling.** N. P. Alexander. Mentions changes made in the algorithm published in *ibid*, **4,** March 1961, 152-153 (*C.A.*, **5,** July 1961, Ref. 1418*f*) when it was coded in FORTRAN for the IBM 7070.

2455 **Uber die Approximation von Funktionen bei der Aufstellung von Unterprogrammen.** (On the approximation of functions in the preparation of subroutines). G. Meinardus and H.-D. Strauer, *Elektronische Datenverarbeitung*, No. 4, 1961, 180-187. (In German) Some methods for computing the best uniform approximation for a given function of one variable in a real interval are described. This problem arises in the preparation of subroutines. Polynomial approximations are considered and it is then shown that approximation by rational functions is often more suitable. For both cases some exchange methods are explained. Some programming details are discussed. 12 refs.

2456 **A 48-bit pseudo-random number generator.** H. G. Kuehn, *Commun. ACM*, **4,** August 1961, 350-352. This paper reports the results of tests of randomness on the following pseudo-random number generator for computers having a 48-bit word length:

$$x_{i+1} = (2^9 + 1)x_i + c \pmod{2^{47}},$$

where $c=29{,}741{,}096{,}258{,}473$ and $x_0=762{,}939{,}453{,}125$. Frequency tests, distributions of certain low-order moments, runs up and down, and runs above and below the mean were applied to 500,000 generated numbers lying within the interval (0,1) and to three sets of integers obtained from specified bits within the generated numbers. The tests substantiated the randomness of all numbers except for the set of integers coming from the least significant bits. 3 refs.

2457 **Correction.** R. G. Saltman, *IRE Trans. Electronic Computers*, **EC-10,** Sept. 1961, 461. Certain misprints in the author's paper 'Reducing computation time for synchronous binary division', *ibid*, **EC-10**, June 1961, 169-174 (*C.A.*, **5,** Aug. 1961, Ref. 1647) are corrected.

2458 **Corrigenda.** *Commun. ACM,* **4,** Sept. 1961, 395. Corrections to 'An iterative method for inversion of power series', J. N. Bramhall, *ibid,* **4,** July 1961, 317-318 (*C.A.,* **5,** Oct. 1961, Ref. 2186) and 'Solution of tridiagonal matrices', R. C. Wenrick, and A. V. Houghton, *ibid,* **4,** July 1961, 314 (*C.A.,* **5,** Oct. 1961, Ref. 2192).

2459 **The generalized important event technique.** N. Shapiro and H. Vreenegoor, *Commun. ACM,* **4,** Sept. 1961, 394-395. Generalisation of the *important event* technique, employed in many Monte Carlo processes, to include global variables other than time, is illustrated by a description of an extreme example of an application in which it was very useful. The application is concerned with the simulation of the behaviour of voluntary muscles according to several stochastic models concerning their contractile mechanism. 1 ref.

2460 **A generalized polyphase merge algorithm.** S. W. Reynolds, *Commun. ACM,* **4,** August 1961, 347-349. A polyphase merge (merging an equal number of sequences from k tapes onto a single unused tape) using $k+1$ tapes is defined in terms of linear combinations of the k-generalised Fibonacci numbers. A method is described to output sequences onto k of $k+1$ tapes after the internal sorting of elements to form sequences. This method will permit a polyphase merge of sequences of sorted elements provided that enough sequences are generated internally to place the proper numbers of sequences on each of the k tapes. For each value of k, there is a set of permissible numbers that can represent the total number of sequences generated during the original output process. If one of these numbers is met exactly and if there is a specific distribution of sequences on the k tapes, then a polyphase merge may proceed. If these conditions are not met, an algorithm, such as described in this paper, is necessary to adjust the numbers of sequences to permit a polyphase merge. 4 refs.

2461 **Inversion of a complex matrix.** L. Tornheim; A. S. Householder, *Commun. ACM,* **4,** Sept. 1961, 398. Tornheim presents a method for inverting a complex matrix and Householder comments on the method. If $C=A+iB$ is a complex matrix with an inverse $C^{-1}=A_1+iB_1$ where A, B, A_1 and B_1 are all real, it is shown how to find C^{-1} by inverting real matrices. 2 refs.

2462 **Manipulation of algebraic expressions.** A. R. M. Rom, *Commun. ACM,* **4,** Sept. 1961, 396-398. This paper is concerned with an algorithm for algebraically manipulating expressions of the form $\sum_{i=1}^{n} C_i\phi_i$ developed in conjunction with the development of programs for systems analysis problems. This algorithm enables over-all system transfer functions to be derived from algebraically described block diagrams of any linear continuous multi-loop feedback system. The machine representation of the derived expression is, by virtue of the algorithm, in a form which simplifies the task of compiling.

2463 **A note on multiple precision arithmetic.** A. G. Cox and H. A. Luther, *Commun. ACM,* **4,** August 1961, 353. In this paper, it is shown that sign analysis can be obviated in a multiple precision addition-subtraction subroutine by making use of means to detect overflow on addition or subtraction. The use of subroutines for special cases to speed the division process is also discussed.

2464 **A note on the system requirements of a digital computer for the manipulation of list structures.** H. Gelernter, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 484-489. It is generally accepted that many non-numerical problems are best programmed within the framework of the so-called Newell-Shaw-Simon associative list memory. However, committing a given program to list memory generally entails accepting a significant loss of speed and efficiency in information processing, so that the advantages accruing from the use of list memory must be carefully balanced against its weaknesses. This paper discusses the system requirements of a digital computer for which the use of list techniques is to be competitive with standard programming, so that the particular memory organisation for a given problem may be chosen on the basis of suitability and ease of programming alone. As an example, modifications to the IBM 7090 for list-processing purposes are described, but engineering and economic feasibility is not implied. 7 refs.

2465 **Optimum tape-writing procedures.** G. K. Hutchinson, *Commun. ACM,* **4,** Sept. 1961, 399-401. When a preprogrammed input/output routine monitors the writing of magnetic tape, a problem arises as to the procedure to be followed when a writing error is detected. The writing error may be due to random effects or physical defects in the tape. The critical factor in determining what procedure to use is the relative frequency of these two causes of writing errors. If an attempt to rewrite is made and no writing error occurs, the program can continue; however, if the writing error persists after one or more attempts, then the tape must be backed up and some length of tape bypassed. Attempting to rewrite the record in the same area is the optimum procedure if most of the writing errors are correctable (i.e. due to random effects), but if most errors are due to defects in the tape, bypassing the defective area immediately is a better procedure. The two procedures are evaluated on the basis of expected loss of computer time and a decision rule is developed for selecting the optimum procedure. A formula is developed to determine the optimum area to be bypassed for each procedure.

2466 **Zum problem der exakten Ermittlung des kürzesten Rundreiseweges.** (On the problem of the accurate determination of the shortest closed paths.) B. Thüring, *Elektronische Datenverarbeitung,* No. 4, 1961, 147-156. (In German) An algorithm is presented for determining the shortest closed path through all given points and two simple examples are given.

2467 **Signed-digit number representations for fast parallel arithmetic.** A. Avizienis, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 389-400. This paper describes a class of number representations which are called *signed-digit* representations. Signed-digit representations limit carry-propagation to one position to the left during the operations of addition and subtraction in digital computers. Carry-propagation chains are eliminated by the use of redundant representations for the operands. Each digit of a positional constant radix number representation with an integer radix r is allowed to assume q values

$$r+2 \leq q \leq 2r-1,$$

that is, more than the r values allowed in conventional number representation. Redundancy in the number representation allows a method for fast addition and subtraction in which each sum or difference digit is the function only of the digits in two adjacent digital positions of the operands. The addition time for signed-digit numbers of any length is equal to the addition time for two digits. The paper discusses the properties of signed-digit representations and arithmetic operations with signed digit numbers: addition, subtraction, multiplication, division and roundoff. Logical design problems for a signed-digit adder are briefly discussed. 9 refs.

2468 **TABSOL—the language of decision making.** T. F. Kavanagh, *Computers & Automn.,* **10,** Sept. 1961, 15, 18-22. A shortened version of the author's paper 'TABSOL—a fundamental concept for systems-oriented languages', *Proc. Eastern Joint Computer Conference,* 1960, 117-136 (*C.A.,* **5,** Sept. 1961, Ref. 1907).

2469 **Workshops in mathematical programming.** *Commun. ACM,* **4,** Sept. 1961, 370-371, 414. A report of the ACM Mathematical Programming Committee describing the Workshops in Mathematical Programming held at the Rand Corporation, Santa Monica, California, 26-31 January 1961. Discussion leaders for each of two two-day workshops summarise their impressions of the direction of current work in the topics concerned:

a. **Algorithms for nonlinear programming.** P. Wolfe, p. 370.

b. **Input-output mechanics for mathematical programming.** W. Smith, p. 370-371.

Lists are presented of participants in the workshops, installations represented at the workshops, and 19 papers distributed at the workshops.

2470 **Computation of elementary functions, in x and ex, in a variable structure computer.** D. G. Cantor, G. Estrin and R. Turn, California University, Los Angeles, *AD-259712,* April 1961, 59 p., $6.60. Sequential table lookup algorithms are proposed for the evaluation of Ln x and exp x. These algorithms are particularly effective when mechanised within the variable structure part of UCLA's proposed Fixed-Plus-Variable structure computer. The sequential table lookup algorithms and their speed advantage over existing subroutine approximation procedures are described. The design of special purpose configurations of the variable structure part of the system which lead to another factor of speed increase as compared to a stored program implementation of the algorithms is presented. The properties of the supervisory control which integrate the operation of the fixed structure general purpose computer and the variable structure special purpose configurations are specified and the over-all computational gains evaluated.

2471 **Data processing program for the filtering, correlation, and power spectral estimation of sampled data.** C. R. Arnold and Z. W. Lenefesky, Electric Boat Div., General Dynamics Corp., *AD-259293,* 28 June 1961, 38 p., $3.60. A data processing program is described for the IBM 704. The program implements the filtering, correlation, and power spectral estimation of sampled data, as well as other minor calculations. A complete list of the specific operations and calculations that the program may be directed to perform is given and the main control program is described. There is also a description of the input-output of the program with an example of an actual program computation. A detailed description of the (relocatable) subroutines which were included in the main program is given.

2472 **Degree of difficulty of computing a function and a partial ordering of recursive sets.** M. O. Rabin, Hebrew University, Israel, *AD-250784 (PB 155232),* 25 April 1960, 20 p., $1.60. An attempt to measure the amount of work inherent in the task of computing a given computable (recursive) function is presented. A notion of degree of difficulty of computing a function is introduced and studied. The notion is invariant in the sense that it is independent of the idealised computers (Turing Machines) used for computing the functions in question. Applications are made to the classification of solvable decision problems (recursive sets) according to relative difficulty. 5 refs.

2473 **A digital computer procedure for least-squares polynomial approximation.** L. N. Beard, Army Ballistic Missile Agency, *AD-259166,* 15 June 1961, 25 p., $2.60. Areas of application of least squares polynomial approximation (polynomial curve-fitting) are suggested and discussed. Suggestions on implementation of the technique are offered. Mathematical descriptions of the method of least squares and application of orthogonal polynomials are included. Flow-charts and a statement listing of a FORTRAN program to accomplish polynomial curve-fitting are also included.

2474 **General Exponential Forecasting: a computer program for the IBM 650.** P. R. Winters, Carnegie Inst. of Technology, *AD-249552 (PB 156872),* Aug. 1960, 25 p., $2.60. The General Exponential Forecasting Program is a computer program written in FORTRAN and compiled for the IBM 650. Machine requirements include: the basic computer, index registers, and floating-point hardware. The following phases of the program are discussed; criteria of prediction accuracy, standard deviations of forecast errors and coefficients of variation, options, data input, data restrictions, output, flow chart, variable dictionary, and program listing.

See also:—
Mathematics: Refs. 2445, 2448, 2449 and 2451.
Applications, Simulation: Ref. 2616*j*.

ACCESSORIES

2475 **Analog to digital converter.** E. J. Levitre, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 50. Description of a circuit employing switched, ordered-magnitude resistors to convert analogue voltages to true binary or binary-decimal.

2476 **Drive for card capacitor memory.** J. K. Shortle, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 38-39. Description of a transistor driver circuit which eliminates crosstalk effects in a card capacitor memory and provides an input signal to it having a minimum pulse width.

2477 **Magnetic eraser.** H. J. Kemp, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 12. Brief description of a device for demagnetising a magnetic drum, which comprises a drum having a number of magnets extending radially from its shaft.

2478 **Optical read-only memory.** H. R. Foglia, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 45. Brief description of a read-only memory comprising a record member, such as an IBM punched card, with a set of light pipes on each side, the two sets being disposed at right angles to one another. Light is passed through a selected pipe of one set and detected after passing through a particular pipe of the other set.

2479 **Readout from magnetic media.** C. O. Pingry, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 29. Description of a circuit for obtaining parallel readout from an asynchronously recorded magnetic medium.

2480 **Comparison of N-ary transmission systems.** J. K. Wolf, Rome Air Development Center, *AD-250293 (PB 154326),* Dec. 1960, 27 p., $2.60. The problem of comparing digital communication systems with various size alphabets is considered. A method of comparison is examined where all systems have as their input and final output an identical form of digital data. The systems are then evaluated on the basis of the resulting error rate in the output digital stream. It is found that the relative performance of systems may depend upon the type of digital data the systems are to carry. Two particular N-ary transmission systems are examined as examples where such comparisons are required. In the first, N orthogonal signals are used in the transmission alphabet, while in the second, $N/2$ orthogonal signals and their negatives are used. In both cases, it is assumed that the signals are corrupted by additive, white Gaussian noise and coherent detection is employed. 5 refs.

2481 **Development of 10 bit airborne analog to digital converter.** G. B. Gilbert and C. W. Barbour, Towson Labs., Inc., *AD-259561,* 16 Jan. 1961, 51 p., $5.60. The development of a radically new type of successive approximation, analogue-to-digital converter employing the rapid and accurate exchange of charge between several capacitors is described. The method makes possible a startling reduction in number of circuit components, total power consumption, size and weight. Furthermore, the technique offers added performance capability with regard to accuracy and speed. Two experimental units were constructed and tested. These units provide 10-bit resolution, 18,181 encodings per second, 200-kc/s bit rate, NRZ output, full-scale input of 0 to +5 volts, input impedance of 1 megohm, inherent sample and hold, continuous operation, or encode upon command. The units use only 45 transistors, require only 6.3 watts from the power supply, and have a volume of only 125 cubic inches and a weight of 3.25 pounds. Recommendations are included for several extensions of the development programme.

2482 **The development of a photomemory.** C. E. Nielsen, Hydel Inc., *AD-248905 (PB 156875),* 1960, 31 p., $3.60. The demonstration reading system of the photomemory performed reliably on 0.006 inch wide bits over a limited plate area. Slight improvements in the illumination system will enable the demonstration reader to perform reliably on a 2×2 inch data plate containing 0.004 inch wide bits. The results thus far indicate that the ultimate desire to read a 4×4 plate containing 0.001×0.004 bits is feasible. Future efforts will be directed towards this end. Efforts on development of the photomemory writing system were confined to showing the basic feasibility of the scheme and selecting the proper materials for further experiments. Data was written on a film in the form of bits approximately 0.006×0.020 inch. This data was reproduced from a track of the data plate at a rate of 20,000 bits/sec. with one mirror scan. More contrast in the negative and smaller bits on the plate are immediate goals and may be achieved by more efficient realisation of the writing light source. A prototype photomemory is anticipated as the result of further developments. A reading system utilising a larger plate and smaller bits as well as a preliminary writing system will be incorporated in the prototype.

2483 **The increasing need for high speed and reliable digital communications.** C. A. Strom, Rome Air Development Center, *AD-250295 (PB 154328),* Dec. 1960, 16 p., $1.60. The trend towards more sophisticated command and control systems, and the application of modern business methods in the control of the vast complex forces in today's Air Force have placed a heavy demand on high speed reliable digital communications. The optimum solution for each system requires a full analysis of the over-all requirements and a balance between the requirements in the over-all system engineering. Optimum solutions for one system may, of itself, be a poor choice for a second and no single optimum solution is available at this time. Early attention must be given to the data transmission problems or exorbitant reoccurring costs will be experienced in the operation of the system.

2484 **Systems research study on optical character recognition.** Farrington Electronics Inc., *AD-259492,* Feb. 1961, 20 p., $2.60. The feasibility was investigated of using optical scanning techniques for converting typewritten material which is created aboard ships to suitable media for input to data processing systems. The accuracy of such conversion was also investigated. The results of analyses and reading tests indicated that material prepared and read under similar conditions (with same type machine that was used in the reading test) would have over-all unreadable and document error rates of 42% and 3.03%, respectively for one pass of the documents through the machine, or 33% and 3.9% respectively for two passes.

2485 **A very high-speed digital number sieve.** D. G. Cantor, G. Estrin et al, California University, Los Angeles, *AD-259131,* May 1961, 22 p., $2.60. A method is presented to sift numbers satisfying a set of linear congruences from among a large set of numbers. The important properties of the resulting special-purpose device are that a relatively large set of numbers is processed essentially within the time required for performing a shift of one position in an ordinary shift-register, and that no memory references are necessary. This leads to an over-all speed gain of about three orders of magnitude over present-day computers such as the IBM 7090. By combining the device with a general-purpose computer, the size of problems that can be run is greatly increased with almost no decrease in speed.

2486 **Magnetic drum system.** British Telecommunications Research Ltd., *B.P. 878085,* 27 Sept. 1961. This patent is concerned with a magnetic drum having a delay track provided with an erasing head to reduce the danger of undesired data being read from the delay track.

2487 **Magnetic tape store.** A.B. Atvidabergs Industrier, *B.P. 878448,* 27 Sept. 1961. A data storage system with a short access time, comprises a series of magnetic tapes each wound on an individual reel. The reels are arranged on parallel shafts located side by side on a common carrier which can be moved to position any reel in a position adjacent driving mechanism for transporting tape on that reel past reading and writing heads.

2488 **Magnetic head positioning system.** Int. Business Machines Corp., *U.S.P. 2994856,* 1 Aug. 1961. This patent describes mechanical and electrical arrangements for positioning a head relative to a magnetic disc.

2489 **Magnetic tape reading system.** Bendix Corp., *U.S.P. 2994857,* 1 Aug. 1961. A magnetic tape reading system is described in which reading heads are moved to scan repeatedly a stationary magnetic tape.

2490 **Buffer store.** Int. Business Machines Corp., *U.S.P. 2997696,* 22 Aug. 1961. An input/output buffer employing an array of magnetic cores is described.

See also:—
Applications, Miscellaneous: Ref. 2624.

ELEMENTS

2491 **A bistable flip-flop circuit using tunnel diode.** V. Uzunoglu, *Proc. IRE,* **49,** Sept. 1961, 1440. Letter describing the operation of a bistable flip-flop cricuit using one tunnel diode and one ordinary diode. 1 ref.

2492 **A card-changeable permanent-magnet-twistor memory of large capacity.** W. A. Barrett, F. B. Humphrey, J. A. Ruff and H. L. Stadler, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 451-461. This paper discusses the card-changeable permanent-magnet-twistor memory—a large capacity (about 10^5 bits) storage system for information that is infrequently changed. The information is stored in the form of small bar magnets bonded to a removable plastic card. The magnets, when magnetised, inhibit the switching of a section of twistor wire at a twistor-wire-solenoid crosspoint. For maximum information density the magnet shape and strength must be optimised with respect to the magnet's action on the inhibited crosspoint and the fringing action on neighbouring crosspoints. Suitable magnet shapes and a general discussion of the stray fields in a large array of magnets are given. 6 refs.

2493 **Coincident-current superconductive memory.** L. L. Burns, G. A. Alphonse and G. W. Leck, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 438-446. This paper describes an approach to the construction of superconductive memories that overcomes most of the difficulties in fabrication and reproducibility through the use of a continuous superconductive film instead of discretely fabricated elements. In a continuous superconductive film memory, elements are obtained through discrete regions of circulation of persistent currents near the intersection of *x-y* conductors deposited on the film. Analysis and confirming experiments show that these regions are stable. The elimination of the edges of the two-hole memory cell removes the main cause of variation of critical currents. Reproducibilities better than 0.25% have been obtained with the continuous film memory. Simplicity of construction permits high bit densities. Memory planes of 100 cells have been made. Advisable speed of operation depends mainly on addressing and sensing circuits. Write-in in 3 nsec was obtained in single elements with only 60 milliamps drive. 8 refs.

2494 **Computer components '61.** *Datamation,* **7,** August 1961, 36-40. A survey of the latest developments in transistors, diodes, tunnel diodes, cryogenic components, magnetic components, parametrons and microminiaturisation.

2495 **Copper-mandrel potentiometer dynamic error and compensation.** C. H. Single and J. A. Brussolo, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 516-523. This paper presents a simple equivalent circuit that is valid for single or multiturn, copper-mandrel, wire-wound precision potentiometers. The equivalent circuit is quite useful in low and moderate frequency error analyses in analogue computers. The circuit is used to develop universal low frequency phase-error curves for various potentiometer capacitive loads. It is then used to form the basis for calculating phase-error reduction through capacitive compensation techniques. The experimental verification of the benefits of such capacitive compensation is described for a ten-segment potentiometer for both low frequency phase error and high frequency transient response. 3 refs.

2496 **Delay line memories.** D. Ellis, *Instr. & Control Systems,* **34,** Sept. 1961, 1655-1657. A general account is given of the use of magnetostrictive sonic delay lines in small low-cost memories for computers. 7 refs.

2497 **Design of a large scale cryogenic memory.** D. R. Young, *Datamation,* **7,** August 1961, 41-43. This paper is concerned with a study of the feasibility of using superconductive devices to replace magnetic cores for a large memory system for a moderate speed, large scale digital computer. The use of the Crowe-RCA scheme and the single cryotron loop for the memory cell is discussed and specifications for two-dimensional and three-dimensional configurations for a proposed 5 megabit memory are presented. Input-output considerations are discussed. 4 refs.

2498 **The Hall-effect analog multiplier.** G. Kovatch and W. E. Meserve, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 512-515. This paper discusses a general purpose four-quadrant multiplier using an indium arsenide Hall-effect element as the basic multiplying device. Circuit diagrams are given for the transistor amplifiers employed. An evaluation of experimental results for a breadboard model is presented. 9 refs.

2499 **High-speed transistorized adders.** D. B. G. Edwards, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 532. Letter referring to 'High-speed transistorized adder for a digital computer', F. Salter, *ibid,* **EC-9,** Dec. 1960, 461-464 *(C.A.,* **5,** Feb. 1961, Ref. 318) and giving references to three papers by the author on a very similar circuit.

2500 **Magnetic devices for digital computers.** D. H. Looney, *Datamation,* **7,** August 1961, 51-55. The properties of ferrite cores, perforated ferrite sheets, twistors and thin magnetic films for data storage are discussed and compared. The use of various magnetic structures for semi-permanent memories is also surveyed. 28 refs.

2501 **Magnetic film memory.** H. J. Oguey, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 42-43. Description of a bit-organised, coincident current memory which employs thin magnetic film elements for storing bits of information. It avoids unwanted domain-wall motion due to half-selects by applying certain drive fields to each element.

2502 **A modulo two adder for three inputs using a single tunnel diode.** K. S. Menger, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 530-531. Letter describing a circuit for a modulo two adder with three inputs which exploits only the essential aspects of the tunnel diode's voltage-current characteristic, so that any negative resistance device could be substituted for the tunnel diode. The extension of the circuit design to other logic elements is discussed.

2503 **Multichannel minimum-amplitude comparator.** R. Roy, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 533-534. Letter discussing the circuit of a comparator for determining which of several data channels contains the minimum-amplitude signal.

2504 **A neuristor prototype.** A. J. Cote, *Proc. IRE,* **49,** Sept. 1961, 1430-1431. This letter describes a lumped-element model of the neuristor which should be suitable for extrapolation to microelectronics form. The model is essentially a cascade of identical active networks, each containing an energy source, an energy-storage mechanism and a negative immittance. The particular circuit described employs a short-circuit stable active element, capacitive storage and a current supply. 3 refs.

2505 **One-tunnel-diode binary.** A. L. Whetstone and S. Kounosu; R. A. Kaenel, *Proc. IRE,* **49,** Sept. 1961, 1445. Letter referring to 'One-tunnel-diode flip-flop', R. A. Kaenel, *ibid,* **49,** March 1961, 622 *(C.A.,* **5,** June 1961, Ref. 1208) describing a one tunnel diode flip-flop requiring a complex shape for the driving pulse. The letter shows that a simple pulse is sufficient and in a brief comment the author agrees.

2506 **Optical erasure of EL-PC and Neon-PC storage elements.** J. A. O'Connell and B. Narken, *Proc. IRE,* **49,** Sept. 1961, 1438-1439. This letter reports a new method of selective optical storage and erasure. Neon-PC and EL-PC bistable elements employing CdS or CdSe photoconductors can be latched and erased by serial irradiation from a single light source of constant intensity, when its emission lies within the sensitive region of the photoconductor. Short (less than 30 msec.) light pulses of sufficient intensity latch optrons; longer (greater than 200 msec.) pulses effect erasure. 7 refs.

2507 **Parametric microwave planar adder.** R. G. Allen and J. E. Mezei, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 17-19. Description of a full binary serial adder which uses carrier phase majority logic and is contained in one plane of stripline structure. The adder uses a plurality of parametric subharmonic oscillators as active components, each of which has at least two terminals from which signals, differing by 180°, are derived.

2508 **Semipermanent storage by capacitive coupling.** D. H. MacPherson and R. K. York, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 446-451. This paper describes a random-access, semipermanent store system using a printed matrix of coupling capacitors. The store has a capacity of 1,024 words, each 34 bits long, and operates in a 3 microsec cycle time. It was developed for a stored-program telephone switching system but is suitable for a program store for digital computers. 8 refs.

2509 **A survey of microsystem electronics.** P. B. Meyers, *Datamation,* **7,** August 1961, 44-47. A brief explanation is given of microsystem electronics and the development of integrated circuitry is outlined. The factors of reliability, size and weight, speed, power consumption, accessibility and cost are then discussed with regard to motives for the development of integrated circuitry.

2510 **Thin magnetic film memories.** E. W. Pugh and W. E. Proebster, *Data Processing (Detroit),* **3,** Sept. 1961, 42-44. An explanation is given of the basic concepts of thin magnetic film memory construction and operation, a comparison is made with ferrite core memories and future possibilities are indicated.

2511 **Three-stable state element.** B. A. Calhoun, *IBM Technical Disclosure Bull.,* **4,** Sept. 1961, 40. Description of a ternary storage element which provides three distinct voltage output levels by employing a core made of a magnetic material, Permivar, which exhibits a wasp-waisted hysteresis characteristic.

2512 **Electroluminescent - photoresponsive computer element research.** Westinghouse Electric Corp., *AD-259395,* 31 Aug. 1960, 85 p., $2.25. Research was concerned with the development of an electroluminescent-photoresponsive (EL-PR) computer element. The objective was the development of a computer element with microsecond switching speed, and impedance ratio of 50 to 1 off to on, and a power gain greater than unity. Existing electroluminescent and photoconductive devices and materials, as well as anticipated improved versions of these devices and materials were analysed. These investigations show that either the microsecond switching speed and the 50 to 1 impedance ratio or the power gain greater than unity and 50 to 1 impedance ratio could be realised with existing materials. However, the achievement of all three objectives in the simple EL-PC (photoconductive) device will require a major breakthrough either in the form of EL materials with greater efficiency or a PC device with inherent gain. 38 refs.

2513 **Silicon semiconductor solid circuits.** J. W. Lathrop, W. Brower and H. Cragon, Texas Instruments Inc., *AD-259376,* May 1961, 91 p., $9.10. Process techniques required for the fabrication of semiconductor networks are being established. Studies of silicon slice preparation, diffusion, contact formation, film dielectrics and test structures are discussed. Equipment assembly techniques for a serial, digital computer are investigated.

2514 **Parallel binary adder.** Philips Electrical Industries Ltd., *B.P. 876989,* 6 Sept. 1961. This patent describes a parallel binary adder which is divided into sections and carries from and into sections are formed according to specified formulae.

2515 **Reversible counter.** Ferranti Ltd., *B.P. 877761,* 20 Sept. 1961. A multi-stage reversible counter, and particularly a decimal counter, employing a multi-cathode glow transfer tube in each stage, is designed to operate at higher speed and with greater accuracy.

2516 **Transistor counter.** Gen. Electric Co., Ltd., *B.P. 877768,* 20 Sept. 1961. This patent describes the circuit design of a counter employing a single transistor per stage.

2517 **Transistor data storage circuit.** Philips Electrical Industries Ltd., *B.P. 878304,* 27 Sept. 1961. A transistor circuit for data storage by means of free charge carriers in the base zone, includes a positive feedback circuit arranged to produce erasure subsequent to an interrogating pulse.

2518 **Decimal counter.** Van der Heem N.V., *B.P. 878333,* 27 Sept. 1961. A decimal counter employs four cascaded bistable circuits with interconnections for converting to decimal counting arranged so that gates are not required.

2519 **Digital integrator.** Bendix Corp., *U.S.P. 2994477,* 1 Aug. 1961. A digital integrator, for a digital differential analyser, is described which is designed to have reduced round-off error.

2520 **Complementing flip-flop.** Burroughs Corp., *U.S.P. 2994788,* 1 Aug. 1961. This patent describes a circuit including two magnetic cores and four transistors which serves as a complementing flip-flop with conditional steering.

2521 **Gate.** Thompson Ramo Wooldridge Inc., *U.S.P. 2994789,* 1 Aug. 1961. A passive gating circuit employing diodes is designed to use a controlling voltage of a magnitude which is significantly smaller than that of the pulses to be gated.

2522 **Shift register.** Int. Business Machines Corp., *U.S.P. 2994854,* 1 Aug. 1961. This patent discloses an improved transfer circuit for a shift register employing a single magnetic core per stage.

2523 **Matrix adder.** Int. Business Machines Corp., *U.S.P. 2995303,* 8 Aug. 1961. An adder comprising a matrix of magnetic cores is described in which selection of a core is effected by the *absence* of selection currents.

2524 **Analogue multiplier.** Gen. Electric Co., *U.S.P. 2995304,* 8 Aug. 1961. Simplified circuitry for effecting multiplication by the quarter-square method is described.

2525 **Analogue multiplier.** Gen. Precision Inc., *U.S.P. 2995305,* 8 Aug. 1961. This patent describes improvements to the transistorised four-quadrant time-division multiplier disclosed in *U.S.P. 2973146 (C.A.,* **5,** Aug. 1961, Ref. 1690).

2526 **Binary counter.** Burroughs Corp., *U.S.P. 2995663,* 8 Aug. 1961. A binary counter employing a trigger circuit consisting of a straight transfer magnetic core circuit connected in a closed loop with an Exclusive-OR magnetic core circuit, and an AND magnetic core circuit.

2527 **Transistor trigger circuit.** Laboratory for Electronics Inc., *U.S.P. 2995668,* 8 Aug. 1961 A trigger circuit employing two transistors is provided with simple arrangements for effecting temperature compensation.

2528 **Shift register construction.** AMP Inc., *U.S.P. 2995731,* 8 Aug. 1961. This patent describes an improved and simplified wiring arrangement and layout for a shift register employing magnetic cores, which facilitates wiring on a mass production basis.

2529 **Magnetic core circuits.** Minneapolis-Honeywell Regulator Co., *U.S.P. 2995732,* 8 Aug. 1961. This patent discloses a magnetic core shift register or logical circuit which has a minimum of energy dissipation in the link coupling a pulse between two cores of the circuit.

2530 **Magnetic core memory matrix.** Minister of National Defence of Canada, *U.S.P. 2995733,* 8 Aug. 1961. A magnetic core memory matrix is wired in a manner which minimises the disturbance caused by spurious signals.

2531 **Analogue multiplier.** Eastman Kodak Co., *U.S.P. 2996252,* 15 Aug. 1961. A description is given of an analogue multiplying circuit designed to multiply an input voltage by a factor which can be set to any selected numerical value within a range bounded by positive and negative limits.

2532 **Combined shift register and counter.** Burroughs Corp., *U.S.P. 2997233,* 22 Aug. 1961. In a shift register operating in binary-decimal, the bistable circuits of one decade are interconnected so as to form a counter.

2533 **Function generator.** Gen. Precision Inc., *U.S.P. 2997235,* 22 Aug. 1961. This patent relates to an all-electronic, transistorised function generator for generating sine and cosine functions.

2534 **Analogue multiplier.** Radio Corp. of America, *U.S.P. 2997237,* 22 Aug. 1961. This patent describes a multiplier of the time sequenced servo type which is adapted to multiply a series of multiplicands by the same multiplier. Essentially, it is an ordinary servo-multiplier with a commutated input to the multiplying potentiometer. A single, inexpensive carbon potentiometer is used and the servo output, together with the multiplicands, is commutated across it.

2535 **Analogue multiplier.** Gen. Dynamics Corp., *U.S.P. 2997238,* 22 Aug. 1961. This patent discloses a circuit for a quarter-square analogue multiplier which combines the high speed of an electronic device with accuracy even greater than the electromechanical servo-operated potentiometer type of multiplier.

2536 **Binary counter circuitry.** Minneapolis-Honeywell Regulator Co., *U.S.P. 2997602,* 22 Aug. 1961. A binary counter stage comprises a bistable circuit employing two transistors or other switching devices coupled by means of a transformer.

2537 **Binary comparator.** Int. Business Machines Corp., *U.S.P. 2997692,* 22 Aug. 1961. A binary comparator is described which employs magnetic cores.

2538 **Cathode ray tube storage systems.** Int. Business Machines Corp., *U.S.P. 2997693,* 22 Aug. 1961. Two cathode ray tube storage systems are described, one for binary-decimal and the other for binary.

2539 **Thin film magnetic core.** U.S. Secretary of the Navy, *U.S.P. 2997695,* 22 Aug. 1961. This patent describes magnetic core storage arrangements provided by the combination of one or more extremely thin continuous films of magnetic alloy with one or two drive wires and a sensing wire extending in planes parallel to the plane of the film.

2540 **Versatile register.** Minister of National Defence of Canada, *U.S.P. 2998192,* 29 Aug. 1961. This patent describes the logic of a register which will shift right, shift left, accept a parallel input, count up, count down, form the one's complement of a stored binary number, can be reset to zero, or can add or subtract three from a number and can shift a number right or left three positions.

2541 **Ternary storage system.** Int. Business Machines Corp., *U.S.P. 2998594,* 29 Aug. 1961. A description is given of a storage system for ternary digital data, employing apertured ferrite cells with three stable states.

See also:—
Design: Ref. 2391.

ANALOGUE

2542 **Design of the ESIAC Algebraic Computer.** M. L. Morgan and J. C. Looney, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 524-529. This paper describes the ESIAC Algebraic Computer, a general purpose analogue computer for rapid calculation and plotting of rational algebraic functions and irrational and transcendental functions which can be expressed in the same general factor form. The computer is based on the concept of a pair of potential-plane factor analogues, in which voltage measurements at the zeros and poles of a function are used for the calculation. The logarithmic complex plane is used in order to represent a wide range of zeros and poles with uniform accuracy. Plotting facilities provide direct graphical output for applications such as frequency response plots and root-locus plots. 3 refs.

2543 **Automatic analogue computer.** Minneapolis-Honeywell Regulator Co., *U.S.P. 2998186,* 29 Aug. 1961. This patent relates to an analogue computer employing electromechanically adjustable potentiometers. Variable input quantities are entered directly into the potentiometers from storage devices in response to a predetermined operating cycle of the computer.

DIGITAL

2544 **The Digital Data Processor.** *Datamation,* **7,** August 1961, 23. Brief, general account of the DDP-19 developed by Computer Control Company for real time processing of engineering data.

2545 **An expandable computer.** G. E. Thorne, *Automn. Progress,* **6,** Sept. 1961, 306-308. An account is given of the main features of the units of the Bull 300 DP Series.

2546 **Programming for the Ferranti Orion computer.** J. F. Davison, *Elektronische Datenverarbeitung,* No. 4, 1961, 163-166. Some details are given of the order code for the Ferranti Orion and the time-sharing arrangements are outlined.

2547 **The M-2 high-speed computer.** M. A. Kartsev, T. M. Aleksandridi et al, *AD-258451,* 20 March 1961, 470 p., $23.50. (Translated from *Gosudarstvennoye Izdatel'stvo Tekhniko-Teoreticheskoy Literatury,* Moscow, 1957, p. 228.) A description is presented of the compact M-2 high-speed computer designed by the Laboratory for Control Computers and Systems of the Academy of Sciences of the USSR. A detailed discussion of the basic units of the machine (arithmetic unit, internal storage units, control unit, and external storage units) is preceded by chapters which set forth the general principle of the machine's construction, its system of number representation and programming, and the layout of the basic elements of its circuits.

2548 **Digital inventory computer.** Digital Control Systems Inc., *U.S.P. 2995729,* 8 Aug. 1961. This patent gives a description of a digital computer designed specifically to handle the maintenance of a running inventory on a number of items whose quantities are constantly subject to change.

PROGRAMMING

2549 **ALGOL 60 reply.** L. D. Turner, D. Dahm, W. Taylor and R. E. Waychoff, *Commun. ACM,* **4,** Sept. 1961, 365. Letter referring to 'Criticisms of ALGOL 60', B. W. Arden, B. A. Galler and R. M. Graham, *ibid,* **4,** July 1961, 309 (*C.A.,* **5,** Oct. 1961, Ref. 2281) and suggesting that the criticisms are based on an incorrect conclusion.

2550 **ALGOL-60, a status report.** J. H. Wegstein, *Datamation,* **7,** Sept. 1961, 24-26. A survey of literature in and about ALGOL, of ALGOL conferences and committees, and of compiler implementation. 16 refs.

2551 **COBOL: a sample problem.** T. M. Mackinson, *Commun. ACM,* **4,** August 1961, 340-346. This paper presents and discusses the flow chart and COBOL program of a simplified merchandise control problem which has been chosen for presenting COBOL to users and potential users of data processing systems.

2552 **Ein Compiler für die Z 22.** (A compiler for the Z 22.) G. Bayer, *Elektronische Datenverarbeitung,* No. 4, 1961, 170-179. (In German) This paper describes a compiler for the Z 22 developed at the Rechenzentrum der Technischen Hochschule Braunschweig. 2 refs.

2553 **Computer software—boon for the user.** L. H. Young, *Control Engng.,* **8,** Sept. 1961, 25-28, 30. A survey of programming packages, including brief, tabulated details of automatic programming systems, application programs and supervisory operating systems provided by manufacturers.

2554 **Documentation—key to promotion.** R. L. Patrick, *Datamation,* **7,** August 1961, 24-25. Informal discussion of why programmers should document their work and of what constitutes documentation of a program.

2555 **Extensions to ALGOL.** R. W. Hockney, *Computer Bull.,* **5,** Sept. 1961, 76. Letter expressing agreement with the comments of J. B. Pollard in 'Extension to ALGOL', *ibid,* **5,** June 1961, 46, 9 (*C.A.,* **5,** Aug. 1961, Ref. 1715). The writer gives the basic idea of his extension to ALGOL 60 which satisfies most of Pollard's requirements.

2556 **The META compiler.** J. Levenson and F. Helwig, *Commun. ACM,* **4,** Sept. 1961, 405-406. Brief account of the characteristics of the META compiler designed as a part of Mitre Corporation's M90 operating system and as a vehicle for research in programming languages.

2557 **The simulation of the Orion time-sharing system on Sirius.** H. P. Goodman, *Computer Bull.*, **5,** Sept. 1961, 51-55. The Orion time-sharing system, as originally envisaged, may lead to inefficient running with certain combinations of programs. This paper describes the use of a simulation program on Sirius to investigate methods of improving the time-sharing and also to examine the advantages of time-sharing between two branches of the same program. It is concluded that the detailed effects of time-sharing are so complicated that it is essential to use simulation on a computer to trace them.

2558 **Standards conventions.** M. Grems; T. G. Sanborn, *Commun. ACM,* **4,** Sept. 1961, 365-366. Two letters commenting on 'Operational compatibility of systems—conventions', G. F. Ryckman, *ibid,* **4,** June 1961, 266-267 (*C.A.,* **5,** Sept. 1961, Ref. 2006).

2559 **A syntactical chart of ALGOL 60.** W. Taylor, L. D. Turner and R. E. Waychoff, *Commun. ACM,* **4,** Sept. 1961, 393 and facing folded chart. This paper presents a chart, produced as a reference aid for writing the ALGOL 60 compiler for the Burroughs B 5000, in which flow-diagram techniques are employed as a means of concisely describing the complete syntax of ALGOL 60.

2560 **What COBOL isn't.** H. Bromberg, *Datamation,* **7,** Sept. 1961, 27-29. After discussing the provision of manuals and other matters to be considered in evaluating compilers, some of the particular aspects of COBOL compilers are considered. The author concludes that 'What COBOL isn't is the final answer; what it is is what you make of it.'

The following abstracts, Refs. 2561 to 2575, are of the papers appearing in *Annual Review of Automatic Programming,* Vol. 2 (see Ref. 2627).

2561 **The use of the Genie system in numerical calculation.** J. K. Iliffe, *Annual Rev. Auto. Programming,* **2,** 1961, 1-28. This paper describes the Genie system, a set of codes designed for interpreting formal expressions on the Rice University computer. 2 refs.

2562 **A description of Mercury Autocode in terms of a phrase structure language.** R. A. Brooker and D. Morris, *Annual Rev. Auto. Programming,* **2,** 1961, 29-65. This paper is a sequel to the authors' two earlier papers: 'An assembly program for a phase structure language', *Computer J.,* **3,** Oct. 1960, 168-174 *(C.A.,* **4,** Dec. 1960, Ref. 2448) and 'Some proposals for the realization of a certain assembly program', *Computer J.,* **3,** Jan. 1961, 220-231 (*C.A.,* **5,** March 1961, Ref. 578). The earlier papers are concerned with what is described as 'an autocode for writing autocodes' with particular reference to a proposed assembly program for Atlas. The system described enables the user to specify by means of 'phrase definitions' and 'statement formats' the form of the statements (and their constituent expressions) to be used in the source language program. The present paper describes how the Mercury autocode language, which is largely a phrase structure language in the sense used by the authors, can be described and defined in terms of such phrase definitions, etc. A proposed translation program for Mercury autocode tapes on Atlas is also discussed.

2563 **Interference with an ALGOL-procedure.** H. Rutishauser, *Annual Rev. Auto. Programming,* **2,** 1961, 67-75. It is a disadvantage of library routines that, after the main program has placed the parameters and transferred control to the subroutine, the main program can only wait until control is transferred back to it. This can be a nuisance in cases where the subroutine executes an iterative process with no *a priori* knowledge of the speed of convergence. A remedy is to build an 'intermediate return' into the subroutine which from time to time gives control back to the main program for a short time during which the main program may check convergence. The same problem arises for ALGOL-procedures, which are the library subroutines for that algorithmic language. Such procedures can hardly be made general enough to contain remedies against all possible kinds of trouble that may occur in all conceivable applications to which they may be put after publication. Part of the responsibility for smooth running of the procedures must be turned over to the user and, in this paper, it is shown how this may be done by an ALGOL-equivalent of the intermediate return.

2564 **The Elliott 803 Autocode Mark 2.** J. Pym and G. K. Findlay, *Annual Rev. Auto. Programming,* **2,** 1961, 77-113. This paper describes the Elliott 803 Autocode Mark 2, a programming aid for the National-Elliott 803, primarily designed for the scientific user, but which could be of use in certain types of commercial application. The calculation to be carried out is first stated as a sequence of instructions written in a mnemonic code which closely resembles ordinary mathematical notation. This mnemonic program is then transcribed on to punched tape and translated into a machine program on the 803 by means of the Autocode Translator.

2565 **MADCAP II.** D. H. Bradford and M. B. Wells, *Annual Rev. Auto. Programming,* **2,** 1961, 115-140. This paper describes MADCAP II, the latest version of the automatic programming compiler for MANIAC II. The paper is intended for reference as well as initial instruction, and is self-contained in that no previous knowledge of MADCAP or other programming system is assumed. New features of MADCAP II are mainly associated with the handling of problem control. A few notational changes, dictated by experience, are concerned chiefly with hand coding, comments and input-output.

2566 **APT, a common computer language.** R. P. Rich, *Annual Rev. Auto. Programming,* **2,** 1961, 141-159. (*N.B.*—The APT language with which this paper is concerned has no connection with the APT —Automatic Programmed Tool—system.) An account is given of the APT language, developed at the Applied Physics Laboratory of the Johns Hopkins University, which is intended to serve as a common computer language for computational problems, i.e. those consisting largely of arithmetic operations inside the machine. A programmer may describe in APT the desired course of computation without regard to the specific type of computer on which the computation is to be done. Any internally programmed computer above a certain minimal strength can be provided with a compiler program which will translate from APT to basic machine language. APT applies the so-called Polish notation to algebraic language, joins it to the iterative subscripting procedure used by A. J. Perlis for his IT language, and then searches for economy of expression in the result.

2567 **SAKO—an automatic coding system.** L. Lukaszewicz, *Annual Rev. Auto. Programming,* **2,** 1961, 161-176. An account is given, with particular reference to its distinguishing features, of SAKO, an automatic coding system for the Polish medium-scale digital computers XYZ and ZAM II. The system takes into account specific features of these machines (for instance, the fact that they are fixed point) and provides for logical operations on machine words. 5 refs. See also Ref. 2568.

2568 **Arithmetic formulae and the use of subroutines in SAKO.** A. W. Mazurkiewicz, *Annual Rev. Auto. Programming,* **2,** 1961, 177-195. This paper describes the arithmetic formulae and methods of using subroutines in the SAKO automatic coding system described in Ref. 2567. The form of permissible expressions and the basic ideas of how SAKO is translated into machine language are given. 6 refs.

2569 **Detailed description of COBOL.** J. E. Sammet, *Annual Rev. Auto. Programming,* **2,** 1961, 197-230. After a brief review of the historical development of COBOL, a detailed description is given of its technical aspects together with appropriate examples.

2570 **FACT—a business compiler: description and comparison with COBOL and Commercial Translator.** R. F. Clippinger, *Annual Rev. Auto. Programming,* **2,** 1961, 231-292. This paper is concerned with FACT, a compiler for business data processing on the Honeywell 800, but which could be implemented on other data processing systems. A description is given of FACT, mainly with the aid of an example of its application to a greatly oversimplified data processing problem (involving the maintenance by a bank of files of the certificates held by stockholders of each of several companies). FACT is then compared, at some length, with the IBM Commercial Translator and COBOL, and it is concluded that FACT is a complete language which can be used to solve a data processing problem without leaving the language at all while a typical data processing job done in COBOL or Commercial Translator would be a mixture of an input editing routine possibly partly out of the language, a sort routine out of the language, and a processing run in the language.

2571 **A critical discussion of COBOL.** A. d'Agapeyeff, M. A. Clark, A. S. Cormack, C. C. Dilloway, A. G. Fraser, B. J. Gibbens, J. C. Harwell, P. M. Hunt, L. J. Jenkins, J. M. MacLeod, D. Maitland, P. Shackleton, J. B. Stringer, E. M. Tribe, H. R. Whiteley and E. L. Willey, *Annual Rev. Auto. Programming,* **2,** 1961, 293-304. This is a report of the Working Committee of the British Computer Society Discussion Group No. 5, on Advanced Programming. It consists almost wholly of adverse criticisms of COBOL, generally and with regard to particular details, together with some general suggestions for improvement. The conclusion of the report is as follows: 'The committee felt that COBOL was not a simple language for programmers, and had been made unnecessarily complex through a close machine orientation. This could have been lessened by leaving certain details, such as mapping of internal storage and conversion of data, to each implementor. The committee also felt that COBOL was not in a form suitable for commonality amongst users in so far as there would be classes of problems which would be unduly difficult to handle. Furthermore full compatibility between machines has not been achieved nor is it apparent where the boundary lies between machines for which COBOL is practicable and those for which it is not. Finally the committee feels that a fresh study is necessary to find a better approach in principle toward commonality in data processing language and machine installation.'

2572 **The growth of a commercial programming language.** H. D. Baecker, *Annual Rev. Auto. Programming,* **2,** 1961, 305-323. This paper is concerned with SEAL, the Standard Electronic Accounting Language, designed for use initially with the Stantec Data Processing System. The paper is intended, not as a reference manual, but to give an outline of the trains of thought behind the genesis of a commercial programming language, and of its structure. 2 refs.

2573 **UNCOL: the myth and the fact.** T. B. Steel, *Annual Rev. Auto. Programming,* **2,** 1961, 325-344. This paper is concerned with the concept of UNCOL, UNiversal Computer Oriented Language, which may be thought of as a linguistic switchbox: problem oriented languages are translatable into UNCOL and, in turn, UNCOL is translatable into machine languages. The author endeavours to show that UNCOL or something similar is essential to the economical wellbeing of the computer industry and that UNCOL is a logical possibility. Some indication is then given of how the UNCOL concept is expected to work.

2574 **General views on COBOL.** J. E. Sammet, *Annual Rev. Auto. Programming,* **2,** 1961, 345-349. This paper was previously published as 'More comments on COBOL', *Datamation,* **7,** March 1961, 33-34 (*C.A.,* **5,** June 1961, Ref. 1266).

2575 **Appendix: Report on the algorithmic language ALGOL 60.** J. W. Backus, F. L. Bauer, J. Green, C. Katz, J. McCarthy, P. Naur, A. J. Perlis, H. Rutishauser, K. Samelson, B. Vauquois, J. H. Wegstein, A. van Wijngaarden and M. Woodger, *Annual Rev. Auto. Programming,* **2,** 1961, 351-390. This report has already appeared in several publications: see *C.A.,* **4,** Refs. 985 and 1293.

2576 **The allocation of storage for arrays in ALGOL-60.** K. Sattley and P. Z. Ingerman, Pennsylvania University, *AD-259780,* Nov. 1960, 15 p., $1.60. This report is apparently the same as the paper in *Commun. ACM,* **4,** Jan. 1961, 60-65 (*C.A.,* **5,** June 1961, Ref. 1282).

2577 **Comments on the implementation of recursive procedures and blocks in ALGOL-60.** E. T. Irons and W. Feurzeig, Pennsylvania University, *AD-259783,* Nov. 1960, 15 p., $1.60. This report appears to be the same as the paper in *Commun. ACM,* **4,** Jan. 1961, 65-69 (*C.A.,* **5,** June 1961, Ref. 1283).

2578 **Dynamic own-array declarations.** P. Z. Ingerman, E. T. Irons et al, Pennsylvania University, *AD-259778,* Nov. 1960, 7 p., $1.60. This report apparently has the same subject as the paper 'Dynamic declarations', *Commun. ACM,* **4,** Jan. 1961, 59-60 (*C.A.,* **5,** June 1961, Ref. 1281).

2579 **Preprocessing of procedures in the ORACLE-ALGOL translator.** L. L. Bumgarner, Oak Ridge National Lab., *CF-61-3-1,* 15 May 1961, 17 p., $1.60.

2580 **Thunks. A way of compiling procedure statements with some comments on procedure declarations.** P. Z. Ingerman, E. T. Irons et al, Pennsylvania University, *AD-259779,* Nov. 1960, 11 p., $1.60. This report is apparently the same as the paper in *Commun. ACM,* **4,** Jan. 1961, 55-58 (*C.A.,* **5,** June 1961, Ref. 1280).

2581 **The treatment of ambiguity and paradox in mechanical languages.** S. Gorn, Pennsylvania University, *AD-259782,* April 1961, 33 p., $3.60. A summary is given of the basic definitions of the theory of mechanical languages, and of the main processors for the prefix languages. A discussion is given of language extension with the examples of hierarchies of extensions in prefix languages. The relationship is established between language extension and increase in control ambiguity. A language of syntactic ambiguity descriptions is designed and the effective processor translating from this language to the derived-language naming language is specified. The concepts of recognition depth for both syntactic ambiguities and analysability of mechanical languages are developed, and examples are given to show the existence of both types at all depths, including infinite depth. Examples of control ambiguity are developed ranging from the extremely useful to the paradoxical. Among the paradoxes analysed in this way are the Epimenides paradox, the Lewis Carroll Tortoise and Achilles paradox, and the Russell paradox.

See also:—
General: Refs. 2375 and 2377.
Design: Ref. 2389.
Digital: Ref. 2546.
Applications, Information Retrieval: Refs. 2599 and 2600.

APPLICATIONS

AERO- AND ASTRONAUTICAL

2582 **Dynamic analysis and preliminary design for satellite guidance subsystem.** Martin Co., *AD-259233,* June 1961, 1 v., $14.50. A self-contained guidance and control system for a hypothetical, unmanned one-year mission in space is presented. System operation is based on the use of altitude measurements to define the in-plane orbit parameters and preselected star occultation time measurements to define the orbit plane orientation parameters. Over-all system operation is presented and system errors are evaluated, using an IBM 7090 program. A detailed description of each of the sub-systems is given and the reliability of these systems is predicted for the one-year mission, using component failure rate data. 24 refs.

See also :—
Electronics: Ref. 2595.

BUSINESS

2583 **Bills for a million.** *Auto. Data Processing,* **3,** Sept. 1961, 18-22. General account of the installation and operation of a system developed by the North Western Gas Board for processing some 1,200,000 quarterly gas accounts. The system employs a National-Elliott 405 computer.

2584 **Electronic data processing and its potential for retailing.** E. Langtry, *Computers & Automn.,* **10,** August 1961, 20-23. A general discussion of the use of electronic data processing systems by retail stores for sales accounting and for sales analysis, with brief summaries of some actual installations.

2585 **Insurance accounting by RAMAC.** B. Clarke, *Data Processing (Detroit),* **3,** Sept. 1961, 38-39. Brief account of how the Kansas City Fire and Marine Insurance Company organise their records on the discs of an IBM 305 RAMAC.

2586 **An on-line management system using English language.** A. Vazsonyi, *Commun. ACM,* **4,** Sept. 1961, 405. Brief account of a Ramo-Wooldridge Corporation demonstration model of an on-line management system which aims to provide increased management capability to executives charged with planning and control of large-scale research, development and production programmes. The management technique is formulated as an exercise in decision gaming.

2587 **The role of the accountant in electronic data processing.** E. A. Leslie, *Computer Bull.,* **5,** Sept. 1961, 56-61. An address given at the 48th Annual Convention of the General Accountants Association (Canada), Chateau Laurier, Ottawa on 15th June 1961. The historical development of the application of mechanisation to accounting is outlined with particular reference to the equipment installed by Canadian Pacific Railways and the way it is used. The impact of electronic data processing on the four main functions of the accountant—general accounting and control, internal audit, professional external audit, and general business intelligence—is discussed.

See also :—
Digital: Ref. 2548.
Programming: Ref. 2551.

CHEMICAL

2588 **Computers in refinery technology.** P. W. Sherwood, *Automn. Progress,* **6,** August 1961, 274-276; Sept. 1961, 309-311, 318. A general account of the use of analogue and digital computers for design and control in oil refineries. 11 refs.

2589 **High field conductance research. The Wien effect and ionic association.** A. Patterson and H. Freitag, Yale University, *AD-258584,* 15 June 1961, 11 p., $3.60. The Onsager-Kim strong electrolyte theory of the Wien effect was programmed for machine computation and was combined with the Onsager weak electrolyte theory in such a way as to account for the high field conductances of associated electrolytes. The computation is a considerable improvement over previous ones, being both more precise and much faster. Graphs are presented of a number of computed results, compared with experimental measurements, illustrating the way in which theory and measurement can be combined to obtain information about ion association. 16 refs.

CONTROL—GENERAL SYSTEMS

2590 **The Fixed-Plus-Variable Computer System in dynamic programming formulation of control system optimization problems. Part I.** M. Aoki and G. Estrin, California University, Los Angeles, *AD-259742,* May 1961, 33 p., $3.60. An initial investigation of the use of the Fixed-Plus-Variable computer to solve a class of control system optimisation problems is reported. In particular, two modes of operations are recognised and the loosely coupled mode is discussed in some detail in an attempt to define functions that the supervisory control must perform and the inventory of the variable structure needed for the problem considered. During the course of this initial study some effective rejection criteria have been evolved which may considerably reduce the amount of interpolation required.

2591 **On the identification and adaptive control of sampled-data systems.** G. G. Lendaris, University of California, Berkeley, *AD-259906,* 21 March 1961, 58 p., $8.60. A procedure is presented for identifying a linear, lumped-parameter, time-invariant (at least during the measurement period), single-input system from its response to a step excitation. Then, an adaptive sampled-data control system is designed using a digital computer to perform this identification procedure and to act as the controller for the system. The system was actually built, and some experimental results are cited. This identification technique requires $2n+1$ measurements of the magnitude of the output, where n is the order of the system and the measurements are taken at equally spaced intervals of time. These measurements are used as the coefficients in n scalar equations whose n unknowns are the coefficients of the z-transformed characteristic equation of the system. This set of n scalar equations is solved for these coefficients (on a digital computer). For some applications, this characterisation of the system is sufficient; when it is not, then this equation is factored to yield the system's z-plane poles, and from this, the corresponding s-plane poles are found. This procedure is independent of initial conditions and will work for any such system (even for the multiple eigenvalue case) the only restriction being that all the poles of the system be excited when the measurements are made.

CONTROL—PRODUCTION AND PROCESS

2592 **Computer controlled production of carbon resistors.** *Instr. Practice,* **15,** Sept. 1961, 1116-1118. An account of Western Electric Company's new production line using a completely computer controlled process for making deposited carbon resistors. The line consists of twelve stations performing the functions of depositing carbon on a ceramic core, inspection, termination, capping, spiralling to value, second inspection, moulding of a protective case, marking, leak inspection, final inspection and packing. An extensively redesigned, general purpose digital computer effects closed loop control with feedback of process data from three key points along the line. Basically, the computer effects production control and statistical quality control, and determines drifts from manufacturing tolerances.

2593 **Stock control in the motor industry.** H. S. Woodgate, *Automn. Progress,* **6,** August 1961, 281-283. After a discussion of the particular problems involved in stock control of parts for motor car production, a general description is given, with flow charts, of the use of a digital computer for such stock control.

ELECTRONICS

2594 **Computing machine aids to a development project.** C. W. Rosenthal, *IRE Trans. Electronic Computers,* **EC-10,** Sept. 1961, 400-406. This paper describes an integrated set of IBM 704 programs—the Development Information Processing System (DIPS)—for performing a sequence of engineering tasks in the development of a digital system. These tasks include the verification of design data, optimal location of electronic logic packages on a chassis, routing of interconnecting wires and the preparation of documents like wiring diagrams and wire running lists. The system also maintains magnetic tape records capable of ready alteration due to design changes. Engineers using the system need not be programmers; a mnemonic language is provided which enables them to instruct the program to perform the selected operations by using a set of order words that can readily be identified with engineering tasks. 4 refs.

2595 **Investigation of computer techniques for radar land mass simulation.** A. S. Corson, Philco Corp., *AD-259993,* Nov. 1960, 91 p., $8.60. This report concerns a study of digital simulation of radar land mass. It is intended to define the problem of digital simulation and to determine the feasibility and practicality of using available techniques and/or equipment in the solution of the problem. Terrain elevation and radar reflectivity characteristics are stored digitally on magnetic tape for a 300 n mi × 1000 n mi problem area. Data is transferred from this raw storage to an intermediate storage level to provide for availability of the entire radar viewing area for all range scales. New data is accessed and the centre of scan of intermediate storage is located as a function of simulated aircraft motion by the flight trainer. The x-y coordinates digital information is converted to analogue form for final storage in a cathode ray storage tube. Methods of digitising elevation and reflectivity data and the applicability of current components and techniques to the solution of the problem is investigated. Based on the technical approach followed in the study programme, digital techniques are feasible but not yet practical for land mass simulation.

2596 **Mathematical circuit analysis and design.** A. Brown, L. R. Hulls et al, Remington Rand Univac Div., *AD-259786,* March 1961, 67 p., $6.60. Mathematical techniques are applied to the analysis of the steady-state performance of a transistor gate-inverter circuit. The statistical calculation of circuit behaviour is discussed and results are presented for the comupter analysis of a typical circuit. A detailed mathematical description of the technique for determining the maximum component tolerance is included and the subsequent statistical study indicates the importance of the maximum tolerance determination in circuit design.

2597 **Special purpose analysis techniques.** R. Archbald, D. Hoffman et al, New York University, *AD-259736,* 31 March 1961, 90 p., $8.60. An experimental program for determining the feasibility of using a general purpose digital computer for signal analysis problems was started. The PB 250 computer and counter-measures receiving set AN/TLR-1 are the major units. A method for using a digital computer to control the operation and interpret the output of a direction finding unit for pulse signals is described. Techniques for implementing the system are outlined. Computer programs to perform the desired system control and data interpretation are developed.

ENGINEERING, ELECTRICAL

See:—
Simulation: Ref. 2616*e*.

ENGINEERING, STRUCTURAL

2598 **Inelastic buckling of columns with elastically restrained ends.** W. H. Collins and O. M. Sidebottom, Illinois University, *AD-258622,* June 1961, 58 p., $6.60. Two methods are presented for constructing curves showing the relationship between average stress and deflection at the central section for columns with elastically restrained ends. Both methods use constant depth of yielding interaction curves, but differ in the assumptions pertaining to the shape of the deflected column. One method assumes that the deflected shape is that of a sine curve. A more exact method divides the column length into several equal segments over which the curvature is assumed to be constant. For the latter method, a digital computer solution is presented. 30 refs.

INFORMATION RETRIEVAL

2599 **An information retrieval language for legal studies.** W. B. Kehl, J. F. Horty, C. R. T. Bacon and D. S. Mitchell, *Commun. ACM,* **4,** Sept. 1961, 380-389. It is pointed out that for lawyers information retrieval involves questions beyond the simple identification of a document by a search. For example, lawyers may be interested in the use of a particular wording or phrase or they may be interested only in citations. Thus an integrated family of programs are required, not merely one search program. This paper describes programs in use at the University of Pittsburgh and examples of their application on an IBM 7070 for information retrieval from statutes.

2600 **Use of MOBL in preparing retrieval programs.** J. Hoffman and A. Opler, *Commun. ACM,* **4,** Sept. 1961, 389-391. MOBL (Macro Oriented Business Language) is designed for use with MICA (Macro Instruction Compiler Assembler), a preprocessor for the SOS system for the IBM 7090. MICA accepts a MOBL program written largely or entirely in the form of macro instructions and converts it to a sequence of one-for-one symbolic machine instructions, then proceeds directly to assemble these and produce 7090 machine language programs. This paper describes how MOBL was extended to enable it to be used for writing certain information retrieval programs.

2601 **Automation of ASTIA-1960.** Armed Services Technical Information Agency, *AD-247000 (PB 171916),* Dec. 1960, 36 p., $1.00. The experiences of the Armed Services Technical Information Agency (ASTIA) in automation during 1960 are presented. The accomplishments of ASTIA in mastering a card-configuration computer are detailed and the plans and present status of a tape-configuration facility are presented. 2 refs.

2602 **Evolution of the ASTIA automated search and retrieval system.** W. E. Hammond, Armed Services Technical Information Agency, *AD-252000 (PB 171915),* Jan. 1961, 71 p., $2.00. This report covers the evolution of the Armed Services Technical Information Agency (ASTIA) automated search and retrieval system. Early considerations and punched card approaches are treated briefly. The current system and programs for the UNIVAC Solid State 90 magnetic tape system are described in detail. Flow charts are included of the program now in use which executes ten simultaneous searches at four levels of coordination. Modification of this program to provide for either ten six-level coordinations or any combination of a 60-descriptor coordination is also discussed. 3 refs.

2603 **The "tape typewriter plan": a method for cooperation in documentation.** C. N. Mooers, Zator Co., *AD-239984 (PB 171909),* July 1960, 25 p., $0.75. The tape-typewriter plan is a plan for cooperation in documentation between libraries, while facilitating the internal clerical and cataloging operations at individual libraries. The plan is based upon the use of a tape-controlled typewriter and the associated use of electronic computers and their related devices. Any individual library requires only a tape typewriter in order to enter the plan and to become a full cooperator. By exchange of tapes between libraries, duplication of bibliographic work at cooperating libraries can be markedly reduced. Conformity to any single classification system or to any specific catalogue card format is not required, since the information processing machines can make new tapes for other formats, and can perform translations from one classification system to another. The information processing machines can also be used for rapid compilation of special indexes, lists, etc., for the documentary resources of all the cooperating libraries. Important aspects are that it does not require setting up a unique large-scale universal documentation centre for processing, search, or storage; it does not require conformity in the choice of tape typewriter equipment; it does not require library ownership of computing equipment; nor does it depend upon any specific choice of computing equipment. 3 refs.

MECHANICAL TRANSLATION

2604 **Investigation and study of graphic-semantic composing techniques.** C. P. Buck, R. F. Pray and G. W. Walsh, Syracuse University, *AD-258974,* June 1961, 1 v., $15.50. The automatic processing of illustrations and graphical data, such as charts, graphs, schematics, and formulae, presents a unique problem in the machine translation of a foreign language publication. This problem may be broken down into six steps, each of which is considered to be a machine operated function: (1) Discernment of the data; (2) Read-off of the data (screening); (3) Translation, if necessary, of verbal or symbolic information which is a part of the data; (4) Recomposition of the graphical data in proper correlation with translated semantic information which it illustrates; (5) Print out of the results of composition into single or multiple hard copy form; and (6) Provision for the storage of results for future retrieval and use. An investigation was made of both existing and potential methods that might be used to achieve the functions indicated in steps 1, 2, 4, 5 and 6. It has been proved that a variety of existing methods could feasibly be combined to partially solve the problem for the immediate future. It is considered feasible, based on the results of this investigation, to achieve fully automated systems for translation or data processing in the not too distant future.

2605 **Research in machine translation, Russian—>English.** H. H. Josselson and A. W. Jacobson, Wayne State University, *AD-248503 (PB 156877),* 31 Aug. 1960, 150 p., $11.00. The principal efforts have been directed toward important aspects of machine translation in the following areas: (1) grammar coding; (2) syntactic analysis; (3) programming; and (4) construction of a glossary (including an investigation of multiple meaning problems).

MEDICAL

2606 **Electrical analog simulation of temperature regulation in man.** R. J. Crosbie, J. D. Hardy and E. Fessenden, Naval Air Development Center, *AD-259077,* 12 June 1961, 21 p., $2.60. Using the basic equations for heat balance which have been developed to take into account heat losses by radiation, convection and evaporation, an electrical analogue has been constructed to simulate the physiological responses to heat and cold in the nude man. Physiologic temperature regulation involves three of the basic types of control modes, namely, proportional control, rate control and some of the characteristics of on-off control. The simulator predicts steady state situations of rectal temperature, skin temperature, metabolic rate, vasomotor state and evaporative heat loss under both resting conditions and exercise. Dynamic responses to sudden shifts in environmental temperature, air velocity, relative humidity and metabolic rate can be simulated to a considerable extent using equations based on the controls outlined above. 11 refs.

MILITARY

2607 **Automatic data processing input-output equipment study. Volume I.** J. M. Van Horn, F. D. Peltz et al, Melpar Inc., *AD-235251 (PB 157019-1),* 1959 (Released to public 20 July 1961), 285 p., $18.00. The development of an integrated automatic data-processing system is investigated. Results are presented of a user-requirements survey to acquaint non-military personnel with the problems faced by a modern field army, and military personnel with the applicability of automatic data processing to these problems. Techniques and equipment for the solution of these problems are also discussed. 1 ref. See also Ref. 2608.

2608 **Automatic data processing input-output equipment study. Volume III.** J. M. Van Horn, F. D. Peltz et al, Melpar Inc., *AD-235252 (PB 157019-3),* 1959 (Released to public 20 July 1961), 118 p., $9.60. The development of an integrated automatic data-processing system is continuing. The study includes a minimum family of input-output equipment for 1960-1965. Changes in the family for 1965-1970, possible adaption of commercial equipment to military usage, a survey of commercial input-output equipment with tabulations of commercial equipment characteristics, and recommendations for development to complete FIELDATA equipment complement. 103 refs. See also Ref. 2607.

2609 **A computer program for the analysis of transient, axially symmetric, explosion and shock dynamics problems.** T. Orlow, D. Piacesi and H. M. Sternberg, Naval Ordnance Lab., *AD-249661 (PB 154218),* 30 Sept. 1960 (Released to public 2 Aug. 1961), 19 p., $1.60. The main features of a program for the analysis of transient axially symmetric explosion and shock dynamics problems are described. The hydrodynamic equations determining the material flow are solved numerically by the von Neumann-Richtmyer method. The program contains routines to accommodate slippage along interfaces between dissimilar materials; e.g., it can be used to determine the flow of gaseous explosion products venting from a metal tube. Results are given showing the computed two-dimensional flow of metals and gases following the detonation of cased solid explosive charges. 7 refs.

NUCLEAR

2610 **Dynamic simulation of multi-pass pressurized water nuclear power plants by analog computer techniques.** J. O. Brondel, Union College, Schnectady, *AD-259638,* June 1961, 130 p., $11.00. A kinetic model of the primary loop of a multi-pass pressurised water reactor power plant is developed to evaluate, by analogue computer techniques, the transient response characteristics due to steam generator load and reactor as a typical plant, transient behaviour patterns are illustrated and examined for a variety of load inputs, variations in plant constants, and analog model simplifications. 69 refs.

2611 **Analogue computer for fallout prediction.** U.S. Secretary of Commerce, *U.S.P. 2998193,* 29 Aug. 1961. This patent describes an analogue computer specifically designed to determine the final ground position of radioactive particles in an atomic cloud.

PHYSICS

2612 **The application of computer techniques to preferred orientation studies.** J. R. Holland, Wright-Patterson Air Force Base, *AD-258594,* Dec. 1960, 13 p., $1.60. A computer technique for plotting normalised pole figures is described and an illustration of the technique applied to data generated using Schulz reflection x-ray diffraction geometry is presented. The computer method enhances the accuracy of the x-ray data and is far less tedious than the usual manual methods of plotting normalised pole figures. Somewhat modified programs should be capable of utilising data generated by other diffraction geometries commonly used in quantitative preferred orientation studies, thus the method is more versatile than a specialised, completely automatic pole figure plotter.

2613 **Monte Carlo application to molecular flows.** J. K. Haviland, M.I.T., *AD-259672,* May 1961, 299 p., $19.75. Monte Carlo methods were programmed on the IBM 709 for two problems: the heat flow between parallel walls using hard sphere and Maxwellian molecules; and the normal shock wave, using hard sphere molecules. Three solutions were obtained to the heat flow problem, two for Maxwellian molecules at Knudsen numbers of 0.53 and 1.64, respectively, and one for hard spheres at a Knudsen number of 2.0. All three runs were at a temperature ratio of 4:1. Three solutions were obtained to the shock wave problem, at Mach numbers of 1.5, 2.0 and 3.0. Solutions were obtained in the heat flow problem to the four-moment full range equations, both for hard sphere and Maxwellian molecules, and one solution was obtained to the six-moment full range equations for Maxwellian molecules.

2614 **Numerical stress analysis of circular cylindrical shells. Part III. A variational solution of the intersection problem.** T. Myint, J. R. M. Radok and M. Wolfson, Polytechnic Inst. of Brooklyn, *AD-259356,* May 1961, 102 p., $9.10. Approximate solutions of an intersection problem for circular cylindrical shells are obtained. The applicability of the method developed for this purpose extends beyond the specific application presented. It is based on the application of the Ritz method to the potential energy stored in the boundary region of the deformed shell. Use of Lagrange multipliers has helped to greatly simplify the algebra. Listings of IBM 704 programs for every stage of the procedure are presented together with input and output information. Numerical results are presented in the form of tables of integrals which permit the application of the method to a wide range of problems. 10 refs.

2615 **The thermodynamic and electrical properties of dissociated combustion gases.** W. C. Moffatt, M.I.T., *AD-259491,* June 1961, 23 p., $2.60. Results are described of an IBM 709 program to calculate the thermodynamic properties of a mixture of dissociating combustion gases. This program computes the equilibrium properties (enthalpy, entropy, molecular weight) of any system involving arbitrary amounts of carbon, oxygen, hydrogen, nitrogen and an inert gas over a wide range of temperatures and pressures.

SIMULATION

2616 **Simulation Council Newsletter.** J. McLeod (Ed.), *Instr. & Control Systems,* **34,** Sept. 1961, 1691-1693, 1695-1698. The main items are as follows:—

a. **Analog+experimental measurements=practical engineer's answer.** T. R. Herndon and R. James, p. 1691-1692.

b. **Some applications of analog computing elements to data reduction and the development of an accuracy-improving device for multipliers.** T. R. Herndon, p. 1692-1693. Analogue solution of telephone trunk loading problem, strain gauge data reduction by analogue circuits, and circuit for automatically changing scale to maintain multiplier accuracy.

c. **Simulation of the fractional derivative operator $\sqrt{s}$ and the fractional integral operator $\sqrt{1/s}$.** G. E. Carlson and C. A. Halijak, p. 1693.

d. **Analog computer study of an adaptive control for closed-loop systems.** C. H. Thomas, p. 1693.

e. **Electronic analog computer representations of induction motors with unbalanced terminal voltages.** P. C. Krause, p. 1693.

f. **Digital approximation of difference equations by trapezoidal convolution.** C. A. Halijak, p. 1693. An approximate Z-transform based upon trapezoidal quadrature is developed to solve a wide variety of differential equations.

g. **A theory of the single-input-output experiment.** P. G. Kirmser, p. 1693. A description is given of the response of a continuous nonlinear system to an arbitrary input in terms of its responses to a finite number of test functions.

h. **Sampled data control systems.** P. M. Julich, p. 1695. Importance of simulation in the analysis and design of sampled data control systems.

i. **Some applications of diode bridges.** J. Spear, p. 1695-1697. Descriptions of the feedback limiter and bridge limiter and their applications to simulation of SPST and SPDT switches, simulation of inelastic stops and function generation.

j. **Analog techniques.** T. C. Anderson, p. 1697-1698. A method of setting integrator capacitors is described.

(*a* and *b* are summaries and extracts of papers given at the Central Simulation Council meeting of 13 March 1961; *c* to *g* are brief descriptions of papers given at the Central Simulation Council meeting of 9 May 1961; and *h* is summary and *i* the full text of papers given at the Southeastern Simulation Council meeting of 14 April 1961.)

TRANSPORT

2617 **Analytical testing in air traffic control.** K. E. Korn, *Computers & Automn.,* **10,** August 1961, 14-16. After a brief discussion of functional and numerical solutions, the value of analysis of a proposed system by means of a computer model is illustrated by an account of a computer model of an air traffic control system with the object of ascertaining what type of control will minimise the amount of fuel used by aircraft in landing at a terminal under crowded conditions.

2618 **Computer finds a railroad car.** *Commun. ACM,* **4,** August 1961, 356. Brief account of a system developed by A. B. Dick Co., Burroughs Corporation, Motorola Communications and Electronics Inc., and Western Union which enables the Denver and Rio Grande Western Railroad to locate any railroad car moving on any line, at any time, in less than a minute. The system employs a microwave network, a facsimile sending-and-receiving equipment, a modified Burroughs 220 and a new system of teletype communications.

MISCELLANEOUS

2619 **Computers in the arts.** J. A. Thie, *Computers & Automn.,* **10,** Sept. 1961, 23-24, 28. An account is given of uses of computers in music (song composition by the Datatron, the Illiac Suite, analysis of music, performance of music), dancing (Markoff chain choreography on the Bendix G-15), literature (abstracting, concordance compilation on IBM 705, sentence structure analysis on SEAC), and drama (writing of sub-plots for typical TV 'westerns' on the TXO computer at M.I.T.). There is a brief general discussion of the goals and drawbacks of computer applications in the arts. 7 refs.

2620 **The use of computers for psychological research.** *Behavioral Science,* **6,** July 1961, 252-270. Consists of the following papers presented at a symposium sponsored by Division 19 of the American Psychological Association and held on 6 September, 1960, in Chicago:—

a. **Introduction: Recent areas of application.** J. E. Coulson, p. 252. Some brief, general remarks on the use of the computer in psychology for data analysis, for simulation and for simulation of and interaction with human subjects.

b. **The computer as a pattern generator for perceptual research.** B. M. White, p. 252-259. Account of experiments at Lincoln Laboratory, M.I.T., in the generation by digital computer of moving patterns for perceptual research. A film is made of a computer-generated cathode ray tube display, the displayed pattern being changed by the program between each frame of the film. 7 refs.

c. **A computer-controlled teaching machine.** H. F. Silberman, p. 259-261. Progress report on a project at System Development Corporation to develop a computer-controlled teaching machine to be used as a research tool for the study of different teaching procedures. The machine consists of a Bendix G-15, a large random access slide projector and an electric typewriter. A student reads instructional items projected from a slide and enters his multiple choice response on the typewriter. The answers are evaluated in the computer in comparison with pre-stored answers. 5 refs.

d. **Computer simulation of interaction in small groups.** A. P. Hare, p. 261-265. This paper is concerned with work on the computer simulation of interaction in small groups at the Laboratory of Social Relations at Harvard University. A comprehensive outline has been developed for a program, called Interaction Simulator, with the object of predicting the actual content and process of small group discussion once the personality characteristics of the members and the discussion topic have been specified. A description is given of investigations of certain small parts of the problem on an IBM 650. For the simulation of a five-man group of college undergraduates with a discussion task, programs have been written for the task activities of individuals, of groups and for the simulation of social-emotional behaviour which goes on concurrently with the task behaviour. 7 refs.

e. **Empirical inputs in a voting model.** W. N. McPhee, p. 265-266. Abstract only of a paper discussing an experimental computer model of the formation of opinion in response to election campaign appeals.

f. **Comments on the use of computers in psychological research.** N. S. Anderson, p. 266-270. This paper discusses the use of the computer as a research tool in psychology with particular reference to the other papers given at the symposium. 3 refs.

2621 **Wirtschaftlichste Kammerlängen im Kalibergbau.** (Economical adit length in potash working.) P. Stahlknecht, *Elektronische Datenverarbeitung,* No. 4, 1961, 157-161. (In German) A method, which has been programmed for the X1 computer, for computing the optimum length of adits in the working and hauling of potash is described. 3 refs.

2622 **Automated teaching machines. An annotated bibliography.** A. A. Beltran, Lockheed Aircraft Corp., *AD-249924 (PB 171898),* Nov. 1960, 54 p., $1.50. Beginning with a summary of the early literature on teaching devices, this annotated bibliography is concerned with teaching machines in the broad sense. It covers devices from simple punchboards to complicated computer-controlled machines capable of providing a four year college course in one year. 82 refs.

2623 **Electronic computer reduction of upper air data.** O. H. Daniel, Eglin Air Force Base, *AD-259300,* 28 June 1961, 20 p., $2.60. Computational techniques included are (1) expressions which will permit the use of the ML-418/AMT-4, or the ML-476( )/AMT Humidity Element, (2) the use of the N-S and E-W components of the surface wind along with the lowest rawin data to obtain the 500-ft wind and the wind at the 1000-mb level, (3) incorporation of a correction to the elevation angles recorded by the Control Recorder to account for the curvature of the earth and the index of refraction, (4) the use of 2-min smoothing for wind computations when elevation angles of the tracking equipment are 15 degrees or higher and 4-min smoothing when elevation angles are below 15 degrees to minimise the effects of antenna hunting at the lower elevation angles, and (5) an expression used for the computation of temperature from radiosonde recorder division values to provide for better accuracy throughout all calibration and scale ranges.

2624 **A feasibility study for a shipboard data collection system.** H. Kaufman and R. Spong, Electric Boat Div., General Dynamics Corp., *AD-259010,* 15 Dec. 1960, 18 p., $2.60. Research is presented on a feasibility study of a shipboard data collection system. The first section describes the background of the study. The second section contains a description of the system that the Electric Boat Division of General Dynamics Corporation suggested in its proposal; it also contains a description of the system for collecting and recording ship speed, course, and elapsed time which was designed and assembled by Electric Boat's Human Factors Section and delivered to SubDevGru Two for installation on two submarines. The third section of this report describes the IBM 704 program developed by Electric Boat's Digital Computer Services Division for post-exercise reconstruction of ship tracks from data recorded during operations at sea.

2625 **A numerical experiment on mesoscale moist convection.** R. L. Inman and T. E. Sanford, Texas A. & M. Res. Foundation, *AD-259149,* Dec. 1960, 63 p., $6.60. Hinklemann's non-geostrophic multilayered model is modified to include the process of condensation and is applied to the problem of mesoscale convection. The atmosphere is assumed to be uniform along one horizontal coordinate. IBM 704 computations were made starting with the same initial wind and temperature fields. In the case where moist air is considered, the initial conditions were chosen to represent two features of the temperature and moisture patterns observed on 11 June 1956 when an instability line developed near a dew-point in western Nebraska.

2626 **Numerical forecasting of humidity, cloudiness and precipitation by means of a computer.** P. K. Dushkin, E. G. Lomonosov and I. N. Lunin (translated by D. Kraus), American Meteorological Society, *AD-258712,* March 1961, 11 p., $1.60. (Translation of *Meteorologiia i Gidrologiia,* **12,** 1960, 3-10.) Advances were made in numerical forecasting of the pressure fields at several levels in the free atmosphere. These forecasts were based on the solution of hydrothermodynamic equations in quasigeostrophic, adiabatic and quasiadiabatic approximations. The quality of the pressure field forecasts can be raised through systematic elimination of these assumptions. Within the framework of the current, comparatively simple, numerical systems of computing pressure, one can forecast a number of meteorological elements: vertical currents, humidity, cloud cover and precipitation. A first attempt is made to solve the problem of forecasting cloudiness and precipitation based on precomputation of the pressure, vertical current and humidity fields.

BOOKS

2627 **Annual Review in Automatic Programming.** R. Goodman (Ed.), Pergamon Press, Vol. 2, 1961, viii+394 pages, £3 10s. 0d. The second volume of the annual series published for the Automatic Programming Information Centre, Brighton College of Technology. The papers are individually abstracted under Refs. 2561 to 2575 in this issue of *Computer Abstracts.*

2628 **Bionics Symposium held in Dayton, Ohio, 13-15 September 1960.** J. C. Robinette (Ed.), Wright-Patterson Air Force Base, *PB 171258,* Dec. 1960, viii + 499 pages, $6.00. This report contains the papers presented at the Bionics Symposium (Living Prototypes—the key to new technology) held in Dayton, Ohio, 13-15 September 1960 and sponsored by the Directorate of Advanced Systems Technology, Wright Air Development Division, Wright-Patterson Air Force Base. The papers are individually abstracted under Refs. 2411 to 2439 in this issue of *Computer Abstracts.*